AD-A201 366 FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT FOR NAVIGATION IMPR..(U) CORPS OF ENGINEERS SOUTH ATLANTIC MOBILE AL COASTAL SECTION.. J K GRAHAM ET AL. 1 6

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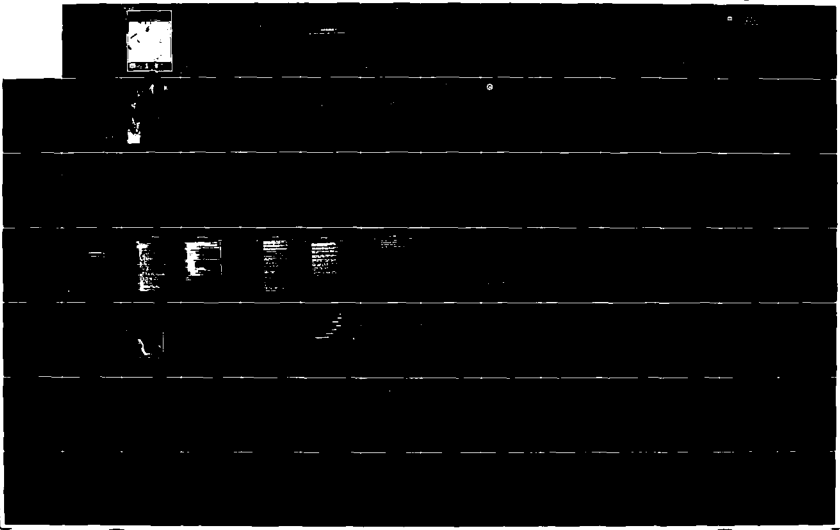

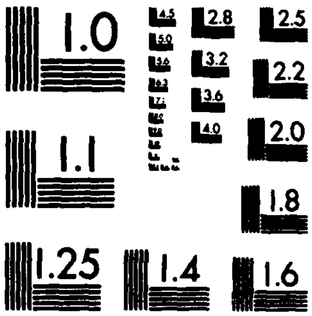

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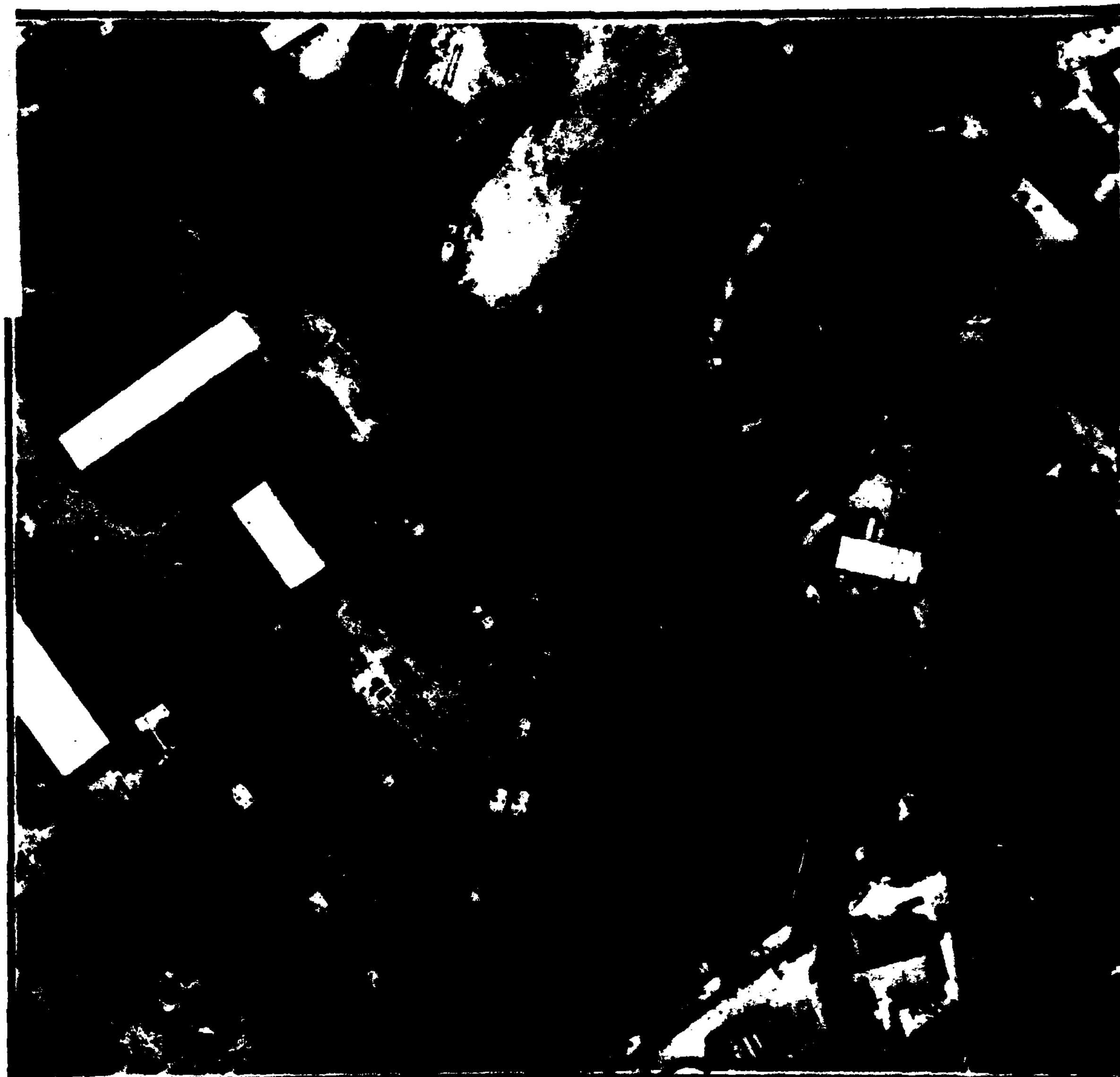
FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT

FOR

NAVIGATION IMPROVEMENTS

AT

BAYOU LA BATRE, ALABAMA



US Army Corps
of Engineers
Mobile District
South Atlantic Divi

APPENDICES

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REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER COESAM/PDFC-88/05	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Appendices Bayou La Batre, Alabama		5. TYPE OF REPORT & PERIOD COVERED Final Feasibility Report Sep 1988
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) John K. Graham Evelyn Brown Susan Ivester Rees, PhD		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. ARMY ENGINEER DISTRICT, MOBILE COASTAL SECTION, PLANNING DIVISION (CESAM-PD-FC) P. O. BOX 2288, MOBILE, AL 36628-0001		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS CESAM-PD-FC P. O. BOX 2288 MOBILE, AL 36628-0001		12. REPORT DATE SEP 1988
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14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
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Approved for public release, distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

NAVIGATION
BAYOU LA BATRE
FEASIBILITY
COMMERCIAL FISHING
ENVIRONMENTAL IMPACT STATEMENT (EIS)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The report consists of a feasibility analysis for channel improvements at Bayou La Batre, Alabama.

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COESAM/PDFC-88/05

Contents:

VOLUME II

APPENDICES

APPENDIX A - PUBLIC INVOLVEMENT, LOCAL COOPERATION AND COORDINATION;

APPENDIX B - ECONOMIC ANALYSIS;

APPENDIX C - INSTITUTIONAL, FINANCIAL AND COST RECOVERY ANALYSIS;

APPENDIX D - ENVIRONMENTAL COMPLIANCE;

APPENDIX E - ENGINEERING DATA AND COST ESTIMATES. Keywords: Channels(Waterways), Dredging. (FR)

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APPENDIX A

PUBLIC INVOLVEMENT AND LOCAL COOPERATION

APPENDIX A

PUBLIC INVOLVEMENT AND LOCAL COOPERATION

TABLE OF CONTENTS

APPENDIX A

PUBLIC INVOLVEMENT AND LOCAL COOPERATION

1. This appendix discusses the coordination and public involvement which went into the preparation of the study. Following this narrative are reproductions of the local cooperation agreement, and letters of comment from the general public. Coordination letters from agencies, with responses as appropriate, have been included in either the Environmental Impact Statement (EIS) or the Environmental Documentation (ED) Appendix.

STUDY PARTICIPANTS AND COORDINATION

2. The Corps of Engineers was responsible for the overall conduct and coordination of the study, consolidation of information from other agencies, formulation of plans, and preparation of the report. At the District level, a multidisciplinary team was used to conduct the study and prepare the report. Early in the study, coordination was primarily with the sponsor to determine local problems and needs. A study cost sharing agreement was negotiated with the City of Bayou La Batre in May 1985 and submitted with the reconnaissance report. The reconnaissance report was approved for initiation of the feasibility study in September 1985, prior to the decision by the Secretary of the Army to proceed with cost sharing. That decision was made in March 1986 and an escrow agreement for the local share of the funds was negotiated and finalized in May 1986. A copy of that agreement is enclosed.

3. A scoping letter was prepared in April 1987 and sent to the Alabama Department of Environmental Management, Alabama Department of Conservation and Natural Resources, National Marine Fisheries Service, Fish and Wildlife Service, Alabama Wildlife Federation, US Environmental Protection Agency, Marine Environmental Sciences Consortium, Sea Grant Advisor Service, Mobile Bay Audubon Society, Metcalf, Ball & Assoc., City of Bayou La Batre, Gulf of Mexico Fishery Management Council, Departments of Sociology & Anthropology and Economics & Finance, University of South Alabama, Master Marine, Inc., and Messrs. Sam J. Kayser, Jr. and Art Dyas. A copy of that letter, with responses and other agency comments, is included in the ED Appendix.

PUBLIC MEETINGS

4. Because the feasibility study was initiated rather quickly after the completion of the reconnaissance report, it was not considered necessary to conduct an initial public meeting for the feasibility study. Close coordination with the City of Bayou La Batre and other local interests was maintained throughout the feasibility phase.

ESCROW AGREEMENT

This ESCROW AGREEMENT made this 21 day of May, 1986 by and between the CITY OF BAYOU LA BATRE, ALABAMA, (hereinafter referred to as the "Local Interest"), and THE FIRST ALABAMA BANK, MOBILE, ALABAMA, a banking institution organized under the laws of Alabama (hereinafter referred to as the "Escrow Agent"), and THE UNITED STATES OF AMERICA (hereinafter referred to as the "Government"), represented by the District Engineer, Mobile District, Corps of Engineers, U. S. Army, Mobile, Alabama.

WITNESSETH:

WHEREAS, the Feasibility Phase Study to investigate channel improvements at Bayou La Batre, Alabama, hereinafter called the "Study", was authorized by a United States House of Representatives Public Works Committee resolution, adopted October 10, 1974; and, funds being appropriated for the Government's Fiscal Year 1986 share of said Study under the Energy and Water Development Appropriation Act for 1986 (Public Law 99-141), and

WHEREAS, the Local Interest, pursuant to certain assurances evidenced by the formal agreement entered into with the Government on 21 May 1985, which is incorporated herein by reference and a copy set forth as Exhibit "A" hereto, has agreed to contribute such funds as are required of Local Interest in connection with the Feasibility Phase Study to investigate channel improvements at Bayou La Batre, Alabama, and

WHEREAS, the Local Interest is desirous of contributing such funds to the Government, the Local Interest's share, based on a Feasibility Phase Study investigating a 14 to 16 foot channel, being currently estimated at $171,500.00, in periodic installments over the period of the Feasibility Phase Study which is a permissible procedure under the provisions of the referenced agreement between the Local Interest and the Government dated 21 May 1985; and

WHEREAS, such periodic installments will be used by the Government in accordance with the referenced agreement dated May 21, 1985 and set forth as Exhibit "A" hereto, and

WHEREAS, the cost attributable to the Local Interest during the ensuing fiscal year 1986 is estimated at $60,000.00, and

WHEREAS, the interest income on this amount of money for the Fiscal Year 1986, as well as sums of money required of the Local Interest during ensuing fiscal years of the Feasibility Phase Study, will be substantial and would be lost by the Local Interest; and

WHEREAS, an escrow agreement will permit the Local Interest to earn such interest income and will also allow the Government to complete the Feasibility Phase Study, subject to the availability of federal funds; and

WHEREAS, it will be necessary that this agreement be renewed or extended to cover fiscal periods subsequent to and including Fiscal Year 1986; and

WHEREAS, it is the desire of the parties hereto to establish an escrow account which will provide for contributions to be made therefrom on account of the Local Interest.

NOW THEREFORE, IT IS HEREBY MUTUALLY AGREED BY AND BETWEEN THE PARTIES AS FOLLOWS:

1. There is hereby created and established with the Escrow Agent an escrow fund pursuant to the terms of this Agreement. The Local Interest will make absolute and irrevocable delivery of an initial sum of money to be determined by the Government to the escrow fund and will deposit under similar conditions such sums of money as are projected by the Government for the succeeding fiscal years during the term of this Agreement, such sums to be deposited prior to 1 October of each succeeding fiscal year.

2. The Local Interest agrees to add to the said deposited sums additional sums if required to meet the Local Interest's share of funds during any particular fiscal year pursuant to the obligation assumed under the aforementioned Local Cooperation Agreement dated 21 May 1985 between the Government and the Local Interest.

3. The Escrow Agent is hereby directed to disburse the said escrow fund to only the District Engineer of the U. S. Army Engineer District, Mobile, Alabama, for the purpose of said Study on demand of the Government as evidenced by written demand of the District Engineer, U. S. Army Engineer District, Mobile, Alabama; with the approval of the Local Interest endorsed thereon.

4. Each requisition for disbursement from this Escrow Fund shall specify:

a. That the disbursement is for proper obligations of the Study expenses and has not heretofore been included in a former requisition; and

b. Amount to be paid.

5. The Government will provide the Local Interest the opportunity to review the basis for all payments to be made from the escrow fund prior to payments being made by the Escrow Agent, provided such review does not delay orderly payments by the Escrow Agent to the Government or award of contract or payments by the Government to its contractors.

6. All payments made by the Escrow Agent shall be drawn to the Finance and Accounting Officer, USA, Corps of Engineers, P. O. Box 2288, Mobile, Alabama 36628-0001.

7. The Escrow Agent shall keep and maintain adequate records pertaining to the escrow fund, and all disbursements therefrom. When the escrow fund has been closed out as provided by paragraph 8 hereof, the Escrow Agent shall file an accounting thereof with both the Government and the Local Interest.

8. Completion or discontinuance of the Study shall be evidenced by filing with the Escrow Agent a certificate signed by the District Engineer, U. S. Army Corps of Engineers, Mobile, Alabama, with the approval of the Local Interest endorsed thereon, which certificate shall set forth the date of completion or abandonment of the Study and that all obligations and costs in connection with the Study, and payable out of the escrow fund, have been paid and discharged. Any balance remaining in the fund shall be remitted to the Local Interest.

9. Monies held for credit of the escrow fund under this Agreement may be kept invested and reinvested by the Escrow Agent in direct obligations of the United States Government or in obligations of Federal Agencies; or, monies may be deposited in interest bearing accounts or in interest bearing Certificates of Deposit with the Escrow Agent to provide for the payment of requisitions for disbursement. Obligations so purchased as an investment shall be held by or under the control of the Escrow Agent and shall be deemed at all times a part of the escrow fund, and interest accruing thereon shall be credited to such escrow fund.

10. The Escrow Agent shall invest any and all cash funds which are not, in its judgment, under present demand, and if upon requisition from the Government, sufficient cash funds do not remain on hand, the Escrow Agent is directed to sell and reduce to cash funds, sufficient amounts of such investments to pay a requisition when presented; and, in any event, shall pay the requisition within ten days after presentation of the requisition for payment.

11. The Escrow Agent shall receive an agreed upon sum annually for its services as Escrow Agent, which shall be paid by the Local Interest. Such payment can be recovered by the Escrow Agent by deducting the necessary amount from the interest accrued on the obligation, or if such accrual is insufficient, by submitting its claim for services to the Local Interest. PROVIDED, HOWEVER, that it is understood and agreed that the Escrow Agent does not have the right to deduct any monies of the principal sum for such services and that any claim for escrow agent services cost which cannot be satisfied from accrued interest must be recovered directly from the Local Interest.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement the day and year first above written.

CITY OF BAYOU LA BATRE, ALABAMA

WITNESS

THE FIRST ALABAMA BANK, MOBILE, ALABAMA

WITNESS

BY:

UNITED STATES OF AMERICA
U. S. ARMY CORPS OF ENGINEERS,
MOBILE DISTRICT

WITNESS

BY:

US Army Corps
of Engineers
Mobile District

PUBLIC MEETING ANNOUNCMENT

A PUBLIC MEETING WILL BE CONDUCTED BY THE MOBILE DISTRICT, U.S. ARMY CORPS OF ENGINEERS TO GAIN PUBLIC INPUT AND TO PRESENT THE RESULTS OF THE DRAFT FEASIBILITY REPORT FOR MODIFICATION OF THE EXISTING FEDERAL CHANNEL AT BAYOU LA BATRE, ALABAMA.

WHEN: AUGUST 24, 1988
7:00 PM

WHERE: BAYOU LA BATRE COMMUNITY CENTER

WHO: ALL INTERESTED PARTIES

SEE ATTACHED SHEETS FOR ADDITIONAL INFORMATION

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

July 28, 1988

REPLY TO
ATTENTION OF:

Coastal Section

NOTICE OF PUBLIC MEETING
AND
PUBLIC INFORMATION BROCHURE

The Mobile District, US Army Corps of Engineers has completed a draft feasibility report and environmental impact statement for deepening and extending the existing Federal navigation project at Bayou La Batre, Alabama. This public meeting is being conducted to present the results of the study and to receive comments from the general public concerning the project.

All interested persons and organizations are invited to attend and participate in the meeting. It is requested that, where possible, important facts or statements regarding the study be submitted in writing for accuracy of record. Written statements may be submitted at the meeting or mailed to the Mobile District in advance. Oral statements made at the meeting will be recorded and made a part of the official record.

The public meeting will be held on:

Wednesday, August 24, 1988
7:00 P.M.
at
Bayou La Batre Community Center
Bayou La Batre, Alabama

We welcome your comments at the meeting; however, if you cannot attend and/or wish to make a written statement in advance, such correspondence should be directed to the District Engineer, US Army Corps of Engineers, Mobile District, ATTN: CESAM-PD-FC, P.O. Box 2288, Mobile, Alabama 36628-0001.

STUDY AUTHORITY

The Bayou La Batre Feasibility Study was authorized by a United States House of Representatives Public Works Committee resolution adopted October 10, 1974. This resolution reads in part:

> "The Board of Engineers for Rivers and Harbors is requested to review the report on Bayou La Batre (House Document 327, 88th Congress, 2nd Session) and other pertinent reports with a view to determining the advisability of modifying the existing project in any way at this time."

EXISTING PROJECT

The existing Federal navigation project at Bayou la Batre, completed in March 1967, consists of a 12' x 100' channel extending from the 12-foot depth contour in Mississippi Sound to a turning basin within the bayou located about 3000 feet downstream of the Highway 188 bridge. From the turning basin, a 12' x 75' channel extends upstream to the Highway 188 bridge. The total length of the existing Federal project is approximately 6.3 miles.

PURPOSE OF THE STUDY

The purpose of the Bayou La Batre Feasibility Study is to investigate the potential for deepening, widening and extending the existing Federal channel and to identify the plan which maximizes net national economic benefits while complying with all environmental laws and regulations.

PLAN FORMULATION

An array of alternative plans were developed for the Bayou La Batre project which included various combinations of channel depths and alignments. These plans included deepening the existing project from the head of the turning basin downstream through the bayou and into Mississippi Sound to alternative depths of 14 feet through 22 feet, alternative alignments through Petit Bois Pass or along the Gulf Intracoastal Waterway, extending a 14' x 75' channel approximately 1500 feet above the Highway 188 bridge, and providing a 12' x 50' channel approximately 1300 feet into Snake Bayou. In conjunction with these alternative channel segments and depths, a number of construction and maintenance dredged material disposal measures were evaluated. Cost estimates were developed for each alternative in order to determine economic feasibility of the project and to identify the plan which maximized National Economic Development (NED) benefits. In addition to maximizing NED benefits, the NED plan is that plan which is in compliance with national environmental statutes, applicable executive orders, and other Federal planning requirements.

TENTATIVELY SELECTED PLAN

Based upon the economic, engineering and environmental analyses of alternative plans evaluated for the Bayou La Batre Feasibility Study, the following generally describes the features of the tentatively selected plan for the project.

- Deepening the existing Federal channel from the mouth of Bayou La Batre to the turning basin to a navigation depth of 18 feet.
- Deepening the existing Federal channel from the turning basin to the Highway 188 bridge to a navigation depth of 14 feet.

- Extending a 14' x 75' channel from the Highway 188 bridge to approximately 1500 feet upstream of the bridge.

- Extending a 14' x 50' channel approximately 500 feet into Snake Bayou, thence a 12' x 50' channel to a point approximately 1300 feet into Snake Bayou.

- Deepening, widening and extending the existing Federal channel within Mississippi Sound south to the Gulf Intracoastal Waterway (GIWW) then westward along the GIWW alignment to the Pascagoula Ship Channel. The dimensions of this channel segment would be an 18-foot navigation depth by a 120-foot width.

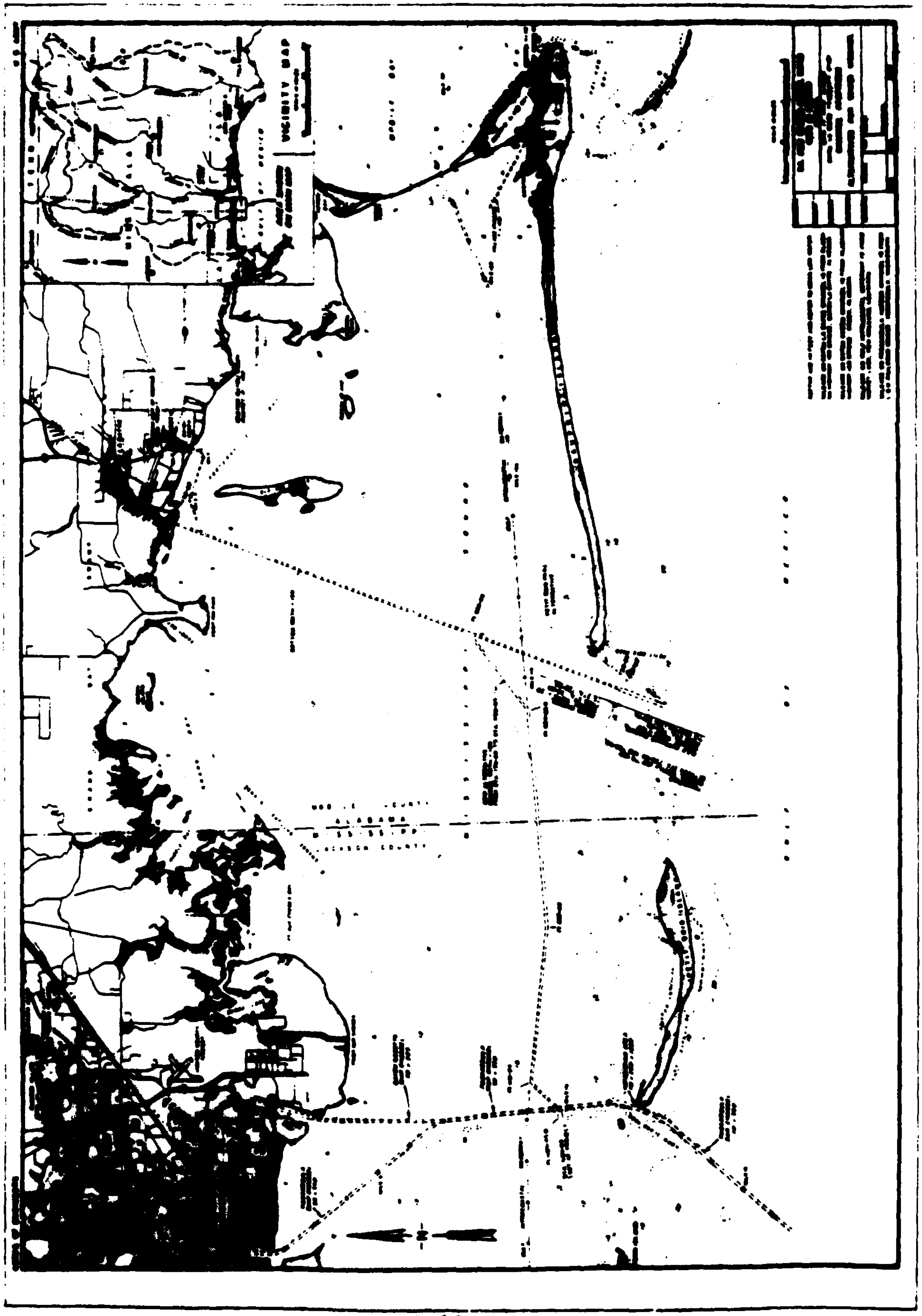
- Construction and maintenance dredged material disposal for this plan would be a combination of upland, island nourishment at Isle aux Herbes (Coffee Island) and open water disposal within Mississippi Sound at depths greater than 12 feet.

The net NED benefits for the tentatively selected plan total $2,613,900 annually with a benefit/cost ratio of 2.2 to 1.

The estimated first costs for construction of the tentatively selected plan are:

FIRST COSTS
TENTATIVELY SELECTED PLAN
($1,000)

	Federal	Non-Federal	Total
LERRD			
Bulkhead/Pier Replacement	$ 0	$23,918.7	$23,918.7
Utility Relocations	0	308.7	308.7
Lands, Diking, Site Prep.	0	901.4	901.4
Berthing Area Dredging	0	138.5	138.5
General Navigation Features			
Channel Dredging	$2,488.7	$ 276.5	$ 2,765.2
Aids to Navigation	36.0	4.0	40.0
Subtotals	$2,524.7	$25,547.8	$28,072.5
E&D	129.3	1,269.7	1,399.0
S&A	90.4	889.1	979.5
Totals	$2,744.4	$27,706.6	$30,451.0



PUBLIC MEETING
BAYOU LA BATRE, ALABAMA
FEASIBILITY STUDY

SUMMARY

A public meeting concerning the draft feasibility report and environmental impact statement was conducted in Bayou La Batre, Alabama at 7 P.M. on August 24, 1988. The meeting was attended by 49 persons plus representatives of the Mobile District study team. The purposes of the meeting were to present the results of the study and to receive comments from all interested parties concerning the project. The following is a summary of the questions and statements made at the meeting and, where appropriate, our responses.

- <u>Several years ago, the State of Alabama pledged a total of $7.5 million toward channel improvements at Bayou La Batre. This money represented one half the estimated cost, based upon a private engineering study funded by interest along the bayou, of deepening the channel to 20 feet. This money, to be paid by the Federal Government, was to come from a portion of the state's share of royalties, leases, sales of land, severence taxes, etc., associated with oil and gas activity within the coastal waters of Alabama. By (Federal) law, these monies must go into a trust fund within the state and only the interest is available for use. There was, however, a proposed amendment for the Federal legislation that would allow a one time use of $7.5 million for channel improvements at Bayou La Batre. The proposed ammendment did not pass and, therefore, the money had to go into the trust fund</u>.

- <u>We are confused by the various costs shown in the report pertaining to bulkhead replacements. What will be the cost of bulkhead replacements at Bayou La Batre from the deepened channel</u>?

  RESPONSE: The draft feasibility report contains both financial and economic costs for bulkhead replacements. The financial costs for bulkhead replacements contained those existing bulkheads that are expected to be replaced due to the effects of a deepened channel and those required for property protection. These costs are estimated at $8.3 million (October 1988 Price Level) for the 18-foot channel and represent the cost of bulkhead replacements for project construction. The economic costs for bulkhead replacements, used to test for economic feasibility of the project, contained those financial costs plus an additional quantity of bulkheads potentially replaced due to berthing area deepening. These costs totaled $21.1 million for the 18-foot channel. The rationale for including these additional replacement costs for plan formulation purposes is that, after the channel is deepened, certain individuals would deepen berthing areas in order to utilize the deeper channel. We have no way of knowing precisely who may deepen

berthing area or when these deepenings may occur; therefore, we made certain assumptions concerning the locations of potentially deepened berthing areas and the effects on existing bulkheads.

- At what proposed channel depth do you begin to affect existing bulkheads with the bayou?

  RESPONSE: Existing bulkheads are affected at all channel depths, 14 through 22 feet, investigated for the study. The level of impact increases, however, with greater channel depth.

- Would everybody along the channel have to have a new bulkhead before the Corps of Engineers would dredge?

  RESPONSE: No. The Corps of Engineers will not specify which individual bulkhead will require replacement. That will be the responsibility of the non-Federal sponsor to determine which bulkheads may fail due to channel deepening obstruct the channel or cause damage to property or development. The Corps of Engineers will require that the non-Federal sponsor hold and save the Federal Government free from damages due to bulkhead failure during project construction except through negligence on the part of the Federal Government or its contractors.

- Would persons have a choice as to whether they would replace their bulkhead or not?

  RESPONSE: Not necessarily. If a bulkhead will obviously fail due to deepening and obstruct the channel, the owner will have no choice but to replace the bulkhead. Again, those determinations of which bulkheads will be replaced and who will bear the cost will be the responsibility of the non-Federal sponsor.

- We met with State Finance Director last week to discuss state sponsorship and financial assistance for the project and the development of a draft financing plan. The State Finance Director currently has his staff working on the financing plan for Bayou La Batre but, due to the special legislative session, he does not expect to be able to complete this plan until after September 1988.

- When would the non-Federal funds be required?

  RESPONSE: Assuming successful implementation of the new Washington level review procedure for this project, expeditious authorization and funding, and fulfillment of the non-Federal sponsorship requirements, project construction could begin within a late 1991 or early 1992 timeframe. The non-Federal sponsor would perform or furnish lands, easements, rights-of-way, bulkhead replacements and dredged material disposal areas during the first year of construction

plus provide a cash contribution for the non-Federal share of the construction, engineering and design of the general navigation features of the project. This cash contribution is currently estimated at a total of $504,600. Of this amount, $359,600 would be required during Fiscal Year 1991 and the remaining $145,000 required during Fiscal Year 1992, based upon the expected construction schedule and expenditures for project construction.

- Does the Corps have a problem with extending the date for when a draft financing plan could be furnished?

  RESPONSE: No, although we would like to obtain one at the earliest possible date. It is also important that the non-Federal sponsor submit a plan that contains as much certainty as possible in regard to amounts and sources of non-Federal revenue for the project.

- The state wants to know what individuals along the bayou as well as the city may do financially as part of the project. What we might expect to see as part of a financing plan would be financial participation on the part of individual owners, the City of Bayou La Batre and the State Of Alabama.

- Is the existing upland disposal area "Charlie" adequate for the project?

  RESPONSE: No. The quantities of construction and maintenance dredged material required to be disposed in upland sites for the 50-year life of the project necessitate the acquisition of an additional upland disposal site. The required size of this new area for an 18-foot deep channel is 107 acres.

- The issue of obtaining permits to replace bulkheads or to build new bulkheads along the bayou is of great concern to us. What will we have to do?

  RESPONSE: The permitting for those existing bulkheads to be replaced and for those identified to be added for property protection as part of project construction have been taken care of as part of this report. You would go to the Corps of Engineers and request a letter of permission to replace an existing bulkhead or to build a new bulkhead in those locations identified as part of this study. You would not have to go through the permit application process or have discussion with any other agencies relative to those bulkheads required as part of project construction. Any further development along the bayou, however, would still go through the normal permitting process.

- Does the study address permitting for any other type of development other than bulkheads along the bayou?

  RESPONSE: Some potential future development is addressed in this study, however, we do not know all of the details that individuals might have concerning future development along the bayou. Without those details, we could not include all potential future development in this study relative to the permitting issue.

- Today we had to have a diver go down and remove debris from the wheel of our butterfish boat. At the present, the method we are using to preserve the butterfish catch onboard the vessel is to place the fish in refigerated sea inside the cargo hold. This entails filling the cargo hold with ice and as you start catching the fish at the usually very rapid rate, they are placed in the refigerated sea water. It is not uncommon for us to catch between 30,000 and 40,000 pounds of butterfish per day. You have to ice them very rapidly by flooding the cargo hold containing the ice with sea water then place the fish in this solution. The reason this is done this way is because butterfish are easily damaged and in order to preserve the catch and maintain the required market quality bringing the best price, they must be preserved in this way. To freeze them in the conventional way and stack them would significantly lower the quality. The boats we use at the present time are large converted shrimp trawlers and because we fill the hold with sea water and catch, we are sinking the boat 3 to 4 feet deeper than normal for this vessel. Because of this, we are having trouble getting into the bayou to unload. We are also having trouble getting our bulk fuel barges into the bayou.

- A petition to close the cut in Coffee Island (Isle aux Herbes) with dredged material was read into the record. The reasons stated to close the cut were:

  - to produce more feeding and nesting areas for waterfowl.

  - to stop erosion of the island.

  - to retain more freshwater within Portersville Bay to help oyster production.

  - to retain the oyster shell from dredged material to help oyster spat.

  - to prevent mud and silt from filling Portersville Bay through the cut.

- ***I do not want the oyster shells that I have planted off the east end of Coffee Island (Isle aux Herbes) covered with dredged material.***

  RESPONSE: This issue has been addressed in the Environmental Impact Statement for the project.

- **Remaining comments were in support of the project stating the future economic opportunities that a deepened channel would afford for the**

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

May 11, 1988

REPLY TO
ATTENTION OF:

Acquisition Branch

SUBJECT: Draft LCA, Bayou La Batre Navigation Project

Honorable J. P. Nelson, Mayor
City of Bayou La Batre
33 South Wintzell Avenue
Bayou La Batre, Alabama 36529

Dear Mayor Nelson:

Enclosed are six (6) copies of a draft Local Cooperation Agreement for the navigation project at Bayou La Batre, for your and the Councils review. Staff from the Mobile District should contact you within the next few days to set up a meeting to discuss and explain this agreement. In the initerim, if you have any questions, please contact Mr. Joseph Givhan at 690-3295.

Sincerely,

L. E. Lewis, Jr.
Acting Chief, Real Estate Division

Enclosures

cc: Maylan Engel
Attorney at Law
Suite 1106
Riverview Plaza Office Tower
Mobile, Alabama 36602

LOCAL COOPERATION

AGREEMENT BETWEEN

THE DEPARTMENT OF THE ARMY

AND

THE CITY OF BAYOU LA BATRE

FOR CONSTRUCTION OF THE NAVIGATION PROJECT AT

BAYOU LA BATRE, ALABAMA

THIS AGREEMENT entered into this _______ day of _______________, 198___ by and between the DEPARTMENT OF THE ARMY (hereinafter referred to as the "Government") acting by and through the Assistant Secretary of the Army (Civil Works), represented by the District Engineer, U.S. Army Engineer District, Mobile, Alabama and the CITY OF BAYOU LA BATRE (hereinafter referred to as the "City"), acting by and through its Mayor,

WITNESSETH THAT:

WHEREAS, the authority for construction of the navigation project at Bayou La Batre, Alabama (hereinafter called the "Project") not specifically authorized by Congress is contained in Section 201 of the Flood Control Act of 1965, (PL 89-298), as amended; and

WHEREAS, construction of the Project is described in a report entitled ____, prepared by the District Engineer, U. S. Army Engineer District, Mobile Alabama, dated _______________, and approved by the Chief of Engineers, U. S. Army, Washington, D. C., on _________________; and

WHEREAS, the Water Resources Development Act of 1986, Public Law 99-662, specifies the cost-sharing requirements applicable to the Project; and

WHEREAS, the City has the authority and capability to furnish the cooperation hereinafter set forth and is willing to participate in project cost-sharing and financing in accordance with the terms of this Agreement;

NOW, THEREFORE, the parties agree as follows:

ARTICLE I - DEFINITIONS

For purposes of this Agreement:

1. The term "general navigation features of the project" shall mean the following project features assigned to commercial navigation: dredging to a depth of 18 feet below mean low water a channel 100 feet wide beginning in the turning basin in Bayou La Batre at station 30+00 and proceeding down the Bayou to the mouth and station 130+00. From station 130+00 south along the existing alignment of the Bayou La Batre ship channel, dredging to a depth of 18 feet below mean low water a channel 120 feet wide to station 536+00, at the intersection with the Gulf Intercoastal Waterway. Then along the Gulf Intercoastal Waterway alignment continuing the 18-foot by 120-foot channel to the intersection with the Pascagoula Ship Channel at station 1185+45. Within the Bayou a channel would be dredged 14 feet below mean low water and 75 feet wide beginning at station 30+00 and running north to station -15+10. Additionally, from the confluence of Snake Bayou with Bayou La Batre, which occurs at the Bayou La Batre turning basin, a channel would be dredged up Snake Bayou 14 feet below mean low water and 50 feet wide from

station 0+00 to station 5+33. From station 5+33 a channel would be extended up Snake Bayou at a depth of 12 feet below mean high water and 50 feet wide to station 13+47.

2. The term "total cost of construction of general navigation facilities assigned to commercial navigation" shall mean all costs incurred by the City and the Government directly related to construction of the general navigation features of project. Such costs shall include, but not necessarily be limited to, actual construction costs, costs of preparation of contract plans and specifications, costs of relocations not performed by or on behalf of the local sponsor, costs of applicable engineering and design, supervision and administration costs, and costs of contract dispute settlements or awards, but shall not include the value of lands, easements, rights-of-way, and dredged material disposal areas, relocations performed by or on behalf of the local sponsor, non-Federal dredging of public or private channels and berthing areas, aids to navigation, nor Government costs for preauthorization studies.

3. The term "period of construction" shall mean the time from the advertisement of the first construction contract to the time of acceptance of the general navigation features of the project by the Contracting Officer.

4. The term "Contracting Officer" shall mean the District Engineer, U. S. Army Engineer District, Mobile, Alabama, or his designee.

5. The term "highway" shall mean any highway, thoroughfare, roadway, street, or other public road or way.

ARTICLE II - OBLIGATIONS OF PARTIES

a. The Government, subject to and using funds provided by the City and appropriated by the Congress, shall expeditiously construct the general navigation features of the project, (including alterations or relocations of highway and railroad bridges), applying those procedures usually followed or applied in Federal projects, pursuant to Federal laws, regulations, and policies. The City shall be afforded the opportunity to review and comment on all contracts, including relevant plans and specifications, prior to the issuance of invitations for bids. The City also shall be afforded the opportunity to review and comment on all modifications and change orders prior to the issuance to the contractor of a Notice to Proceed. The Government will consider the views of the City, but award of the contracts and performance of the work thereunder shall be exclusively within the control of the Government.

b. The Government shall operate and maintain the general navigation features of the project.

c. The City shall provide and maintain, at its own expense, all project facilities other than those for general navigation, including dredged depths commensurate with those in related general navigation features in berthing areas and local access channels serving the general navigation features.

d. As further specified in Article III hereof, the City shall provide to the Government all lands, easements, rights-of-way, including dredged material disposal areas, and perform all relocations or alterations of facilities other than utilities governed by paragraph e. below (except relocations or alterations of highway and railroad bridges), determined by the Government to be necessary for construction, operation, or maintenance of the project.

e. As further specified in Article III hereof, the City shall perform or assure performance of all utility relocations or alterations determined by the Government to be necessary for construction, operation, or maintenance of the project.

f. As further specified in Article VI hereof, the City shall provide, during the period of construction, a cash contribution equal to the following percentages of the total cost of construction of the general navigation facilities assigned to commercial navigation:

1. 10 percent of the costs attributable to the portion of the project which has a depth not in excess of 20 feet;

2. 25 percent of the costs attributable to the portion of the project which has a depth in excess of 20 feet but not in excess of 45 feet; and

3. 50 percent of the costs attributable to the portion of the project which has a depth in excess of 45 feet.

g. As further specified in Article VI hereof, the City shall repay with interest, over a period not to exceed 30 years following completion of the project or separable element thereof, an additional 0 to 10 percent of the total cost of construction of general navigation facilities assigned to commercial navigation, depending on the value, as calculated under Article

IV hereof, of items provided pursuant to paragraph d. of this Article. If the credit allowed for such items is less than 10 percent of the total cost and the percentage of the total cost represented by the value of such items. If the credit allowed is equal to or greater than 10 percent of said total cost, the City shall not be required to repay any additional percentage of the total cost.

ARTICLE III - LANDS, FACILITIES, AND RELOCATION ASSISTANCE

a. Prior to the advertisement of any construction contract, the City shall furnish to the Government all lands, easements, and rights-of-way, including suitable borrow and dredged material disposal areas, as may be determined by the Government to be necessary for construction, operation, and maintenance of the general navigation features, and shall furnish to the Government evidence supporting the City's legal authority to grant rights-of-entry to such lands.

b. The City shall provide or pay to the Government the full cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, determined by the Government to be necessary for construction, operation, or maintenance of the general navigation features.

c. Upon notification from the Government, the City shall accomplish all necessary alterations and relocations of buildings, highways, railroads, storm drains, and other facilities, structures, and improvements.

d. Upon notification from the Government, the City shall perform or assure performance of all necessary alterations and relocations of pipelines, cables, and other utilities. Nothing herein shall be deemed to affect the ability of the City to seek compensation from other non-Federal entities for costs it incurs under this paragraph.

e. The City shall comply with the applicable provisions of the Uniform Relocations Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, approved January 2, 1971, as amended, in acquiring lands, easements, and rights-of-way for construction and subsequent operation and maintenance of the Project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

ARTICLE IV - VALUE OF LANDS AND FACILITIES

a. The value of the lands, easements, and rights-of-way to be credited toward the additional 10 percent of total costs the City must repay pursuant to Article II.g. will be determined in accordance with the following procedures:

1. If the lands, easements and rights-of-way are owned by the City as of the date this Agreement is signed, the credit shall be the fair market value of the interest at the time such interest is made available to the Government for construction of the project. The fair market value shall be determined by an appraisal to be obtained by the City which has been

prepared by an independent and qualified appraiser who is acceptable to both the City and the Government. The appraisal shall be reviewed and approved by the Government.

2. If the lands, easements and rights-of-way are to be acquired by the City after the date this Agreement is signed, the credit shall be the fair market value of the interest at the time such interest is made available to the Government for construction of the project. The fair market value shall be determined as specified in subparagraph 1. above. If the City pays an amount in excess of the appraised fair market value, it may be entitled to a credit for this excess amount if the City has secured prior written approval from the Government of its offer to purchase such interest.

3. If the City acquires more lands, easements or rights-of-way than are necessary for project purposes, as determined by the Government, then only the value of such portions of those acquisitions as are necessary for project purposes shall be included in total project costs and credited to the City's share.

4. Credit for lands, easements and rights-of-way in the case of involuntary acquisitions which occur within a one-year period preceding the date this Agreement is signed or which occur after the date this Agreement is signed will be based on court awards, or on stipulated settlements that have received prior Government approval.

5. For lands, easements, or rights-of-way acquired by the City within a five-year period preceding the date this Agreement is signed, or any time after this Agreement is signed, credits provided under this paragraph will also include the actual incidental costs of acquiring the interest, e.g., closing and title costs, appraisal costs, survey costs, attorney's fees, plat maps, and mapping costs, as well as the actual amounts

expended for any relocation assistance provided in accordance with the obligations under this Agreement.

b. The costs of relocations or modifications of facilities (other than utilities) which will be credited towards the additional 10 percent of total costs the City must repay pursuant to Article II.g. will be that portion of the actual costs incurred by the City as set forth below:

1. Highways: Only that portion of the cost as would be necessary to construct substitute highways to the design standard that the State of Alabama would use in constructing a new highway under similar conditions of geography and traffic loads.

2. Facilities (Other than utilities): Actual relocation cost, less depreciation, less salvage value, plus the cost of removal, less the cost of betterments. With respect to betterments, new materials shall not be used in any relocation or alteration if materials of value and usability equal to those in the existing facility are available or can be obtained as salvage from the existing facility or otherwise, unless the provision of new material is more economical. If, despite the availability of used material, new material is used, where the use of such new material represents an additional cost, such cost shall not be credited to the City's share.

c. No credit shall be given for any costs relating to relocations or alterations of utilities.

ARTICLE V - CONSTRUCTION PHASING AND MANAGEMENT

a. To provide for consistent and effective communication between the City and the Government during the term of construction, the City and the Government shall appoint representatives to coordinate on scheduling, plans,

specifications, modifications, contract costs, and other matters relating to construction of the Project.

b. The representatives appointed above shall meet as necessary during the term of project construction and shall make such recommendations as they deem warranted to the Contracting Officer.

c. The Contracting Officer shall consider the recommendations of the representatives in all matters relating to the Project, but the Contracting Officer, having ultimate responsibility for construction of the Project, has complete discretion to accept, reject, or modify the recommendations of the representatives.

ARTICLE VI - METHOD OF PAYMENT

a. The City shall provide, over the term of construction, the percentages of the total cost of construction of general navigation facilities assigned to commercial navigation specified in Article II.f. hereof. Such cost is presently estimated to be $5,046,000.00. In order to meet its share, the City must provide a total cash contribution presently estimated to be $504,600.00.

b. The City shall provide its required cash contribution in proportion to the rate of Federal expenditures over the term of the construction period in accordance with the following provisions:

1. For purposes of budget planning, the Government shall notify the City by ____________ of each year of the estimated funds that will be required from the City to meet its share of project costs for the corresponding Government fiscal year.

2. Sixty (60) days prior to the award of the first construction contract, the Government shall notify the City of its share of project costs, including costs attributable to the project incurred prior to the initiation of construction, for the first fiscal year of construction. Within 30 days thereafter, the City shall [select one: *provide the requisite* amount to the Government in cash by delivering a check payable to "FAO, USAED, Mobile" to the Contracting Officer OR verify to the satisfaction of the Government that it has deposited the requisite amount in an escrow account acceptable to the Government, with interest accruing to the City, OR present to the Government an irrevocable letter of credit acceptable to the Government in an amount sufficient to meet its obligation].

3. For the second and subsequent fiscal years of project construction, the Government shall, 60 days prior to the beginning of the fiscal year, notify the City of its share of project costs for that fiscal year. No later than 30 days prior to the beginning of the fiscal year, the City shall make the necessary funds available to the Government through the funding mechanism specified above.

4. If at any time during the period of construction the Government determines that additional funds will be needed from the City to meet its initial share of project costs, the Government shall so notify the City and the City, within 30 days from receipt of notice, shall make the necessary funds available through the funding mechanism specified above.

c. The Government will draw on the [funds, OR escrow account, OR letter of credit] provided by the City such sums as it deems necessary to cover contractual and in-house fiscal obligations attributable to the project as they are incurred, as well as project costs incurred by the Government prior to the initiation of construction.

d. Upon completion of the general navigation features of project and resolution of all relevant contract claims and appeals, the Government shall compute the total cost of construction of general navigation facilities assigned to commercial navigation and tender to the City a final accounting of its share of project costs. In the event the total contribution by the City is less than its initial required share of project costs at the time of the final accounting, the City shall, within 90 calendar days after receipt of written notice, make a cash payment to the Government of whatever sum is required to meet its minimum required share of project costs. In the event the City has made cash contributions which result in the City's having provided more than its initial required share of project costs, the Government shall credit the excess to the additional amount the City must repay pursuant to Articles II.g. and II.h. of this Agreement.

e. The City shall repay the additional amount required pursuant to Article II.g. of this Agreement, reduced by any excess cash contribution made during the term of construction, in equal annual installments over a period of not more than 30 years from the date the final accounting is tendered by the Government. Such repayment shall include interest at a rate determined by the Secretary of the Treasury, taking into consideration the average market yields on outstanding marketable obligations of the United States with remaining periods to maturity comparable to the repayment period, during the month preceding the fiscal year in which costs for the construction of the project are first incurred (or, in the case of recalculation, the fiscal year in which the recalculation is made), plus a premium of one-eighth of one percentage point for transaction costs. The interest rate shall be recalculated by the Secretary of the Treasury at five-year intervals. Nothing herein shall preclude the City from repaying

this additional amount in full upon receipt of the final accounting. Should this full repayment be made within 90 days from receipt of the final accounting, there shall be no charges for interest or transaction costs.

ARTICLE VII - DISPUTES

Before any party to this Agreement may bring suit in any court concerning an issue relating to this Agreement, such party must first seek in good faith to resolve the issue through negotiation or through other forms of alternative non-binding dispute resolution mutually acceptable to the parties.

ARTICLE VIII - OPERATION, MAINTENANCE, AND REHABILITATION

a. The City shall operate and maintain all portions of the project, except for general navigation features and aids to navigation, in accordance with regulations or directions prescribed by the Government.

b. The Government shall operate and maintain the general navigation features of the project.

c. The City hereby gives the Government a right to enter, at reasonable times and in a reasonable manner, upon land which it owns or controls for access to the Project for the purpose of completing, operating, repairing, and maintaining the Project. If an inspection shows that the City for any reason is failing to fulfill its obligations under this Agreement without receiving prior written approval from the Government, the Government will send a written notice to the City. If the City persists in such failure for 30 calendar days after receipt of the notice, then the

Government shall have a right to enter, at reasonable times and in a reasonable manner, upon lands the City owns or controls for access to the Project for the purpose of completing, operating, repairing, or maintaining those portions of the Project for which the City is responsible under this Agreement. No completion, operation, repair, or maintenance by the Government shall operate to relieve the City of responsibility to meet its obligations as set forth in this Agreement, or to preclude the Government from pursuing any other remedy at law or equity to assure faithful performance pursuant to this Agreement.

ARTICLE IX - RELEASE OF CLAIMS

The City shall hold and save the Government free from all damages arising from the construction, operation, and maintenance of the Project, except for damages due to the fault or negligence of the Government or its contractors. This shall specifically include, but is not limited to, all damages due to or arising from the complete or partial failure of any bulkhead, retaining wall, pier or other structure located along the Bayou.

ARTICLE X - MAINTENANCE OF RECORDS

a. The Government and the City shall keep books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to this Agreement to the extent and in such detail as will properly reflect total project costs. The Government and the City shall maintain such books, records, documents, and other evidence for a minimum of three years after completion of construction of the Project and resolution of all claims

arising therefrom, and shall make available at their offices at reasonable times, such books, records, documents, and other evidence for inspection and audit by authorized representatives of the parties to this Agreement.

b. The City shall prepare maps of all lands, easements and rights-of-way obtained by it for construction of the Project. Upon completion of the Project, the City shall provide the Government a copy of said maps.

ARTICLE XI - FEDERAL AND STATE LAWS

In acting under its rights and obligations hereunder, the City agrees to comply with all applicable Federal and State laws and regulations, including Section 601 of Title VI of the Civil Rights Act of 1964 (Public Law 88-352) and Department of Defense Directive 5500.II issued pursuant thereto and published in Part 300 of Title 32, Code of Federal Regulations, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army."

ARTICLE XII - RELATIONSHIP OF PARTIES

The parties to this Agreement act in an independent capacity in the performance of their respective functions under this Agreement, and neither party is to be considered the officer, agent, or employee of the other.

ARTICLE XIII - OFFICIALS NOT TO BENEFIT

No member or delegate to the Congress, or resident commissioner, shall be admitted to any share or part of this Agreement, or to any benefit that may arise therefrom.

ARTICLE XIV - COVENANT AGAINST CONTINGENT FEES

The City warrants that no person or selling agency has been employed or retained to solicit or secure this Agreement upon agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the City for the purpose of securing business. For breach or violation of this warranty, the Government shall have the right to annul this Agreement without liability, or, in its discretion, to add to the Agreement or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fee.

ARTICLE XV - TERMINATION OR SUSPENSION

a. If at any time the City fails to make the payments required under this Agreement, the Government shall terminate or suspend work on the Project until the City is no longer in arrears, unless the Government determines that continuation of work on the Project is in the interest of the United States. Any delinquent payment shall be charged interest at a rate, to be determined by the Secretary of the Treasury, equal to 150 per centum of the average bond equivalent rate of the 13-week

Treasury bills auctioned immediately prior to the date on which such payment became delinquent, or auctioned immediately prior to the beginning of each additional 3-month period if the period of delinquency exceeds 3 months.

b. If the Government fails to receive annual appropriations in amounts sufficient to meet expenditures for the then-current or upcoming fiscal year, the Government shall so notify the City. After 60 days either party may elect without penalty to terminate the Agreement or to suspend performance thereunder, and the parties shall conclude their activities relating to the project and proceed to a final accounting in accordance with Article VI.

ARTICLE XVI - NOTICES

a. All notices, requests, demands, and other communications required or permitted to be given under this Agreement shall be deemed to have been duly given if in writing and delivered personally, given by prepaid telegram, or mailed by first-class (postage-prepaid), registered, or certified mail, as follows:

If to the City:

City of Bayou La Batre

If to the Government:

U. S. Army Corps of Engineers, Mobile District
P. O. Box 2288
Mobile, Alabama 36628-0001

b. A party may change the address to which such communications are to be directed by giving written notice to the other in the manner provided in this section.

c. Any notice, request, demand, or other communication made pursuant to this Article shall be deemed to have been received by the addressee at such time as it is personally deliverde or on the third business day after it is mailed, as the case may be.

ARTICLE XVII - CONFIDENTIALITY

To the extent permitted by the law governing each party, the parties agree to maintain the confidentiality of exchanged information when requested to do so by the providing party.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the day and year first above written.

THE DEPARTMENT OF THE ARMY

BY: ______________________
LARRY S. BONINE
Colonel, Corps of Engineers
District Engineer

DATE: ______________________

THE CITY OF BAYOU LA BATRE

BY: ______________________
MAYOR

DATE: ______________________

CERTIFICATION OF AUTHORITY

I, ______________________________, do hereby certify that I am the Attorney of the CITY OF BAYOU LA BATRE; that the City of Bayou La Batre is a legally constituted public body with full authority and legal capability to perform the terms of the Agreement between the Department of the Army and the City of Bayou La Batre in connection with the Project and to pay damages, if necessary, in the event of the failure to perform, in accordance with Section 221 of Public Law 91-611, and that the Mayor who has executed this Agreement on behalf of the City of Bayou La Batre, has acted within his statutory authority.

IN WITNESS WHEREOF, I have made and executed this certification this ______ day of ________________, 198____.

____
ATTORNEY

City of Bayou La Batre

33 South Wintzell Ave., Bayou La Batre, AL 36509 (205) 433-1906/824-2171

"Seafood Capital of Alabama"

Mayor
J. F. 'Jiggs' Nelson

Council Members
Tom Lamey
Arlen Lyons
Tyler Peek
Leverne Simmons
Robert West

City Clerk
Imelda McClellan

September 7, 1988

Colonel Larry S. Bonine
District Engineer
Mobile District
U. S. Army Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

Dear Colonel Bonine;

This letter is to express the interest and support of the City of Bayou La Batre in the proposed channel deepening project. The channel improvements described as part of the tentatively selected plan in the draft Feasibility Report would be of significant economic benefit to the City of Bayou La Batre, Mobile County and the State of Alabama.

Recognizing the requirement for non-Federal sponsorship of the project, the City of Bayou La Batre is pursuing the possibility of the State of Alabama serving as the non-Federal sponsor for the project. We are also investigating alternative means of financing a portion of the non-Federal share of project costs at the locate level to supplement any financial assistance from the state. These alternatives included the formation of a private nonprofit corporation, special assessments by the city on improvements to property from the project, and the formation of a port authority. The most promising alternative, however, is the formation of a private, nonprofit corporation to enter into an agreement with the City of Bayou La Batre to supplement potential state funding and to finance certain aspects of the project. Such a corporation was formed in 1987 to finance a $1.2 million wastewater outfall line for the city.

Officials of the City of Bayou La Batre and representatives from the private sector have met with state officials on a number of occasions to discuss non-Federal sponsorship of the project. Although no formal commitment has been made by the state, these meetings have been encouraging. The Governor's staff is presently reviewing documents produced by the Feasibility Study to assess the potential for the state to serve as the non-Federal sponsor or to otherwise participate financially in the project.

The City of Bayou La Batre fully supports the proposed channel improvement project and we will do what we can to provide, within our capability, whatever assistance, be it financial and otherwise, which may be required to achieve a successful completion.

Sincerely,

J. F. Nelson

J. F. Nelson
Mayor

JFN:mm

APPENDIX B

ECONOMIC ANALYSIS

TABLE OF CONTENTS (Con't)

Page No.

LIST OF TABLES

(Con't)

Table No.		Page No.
	Population for Selected Years and Population Characteristics of Bayou La Batre, Mobile County [illegible] 1980	3
	[illegible] Characteristics of Bayou La Batre, Mobile County and the State of Alabama, 1980	4
	Employment and Income Characteristics of Bayou La Batre, Mobile County and the State of Alabama	4
4	Seafood Commercial Landings	7
5	Shrimp vs Fisheries Landed at Bayou La Batre 1980-1986	8
5A	Seafood Earnings, Bayou La Batre, 1986	9
6	Average Annual Revenue Costs Associated with Operating a Large Shrimping Vessel out of Bayou La Batre July, 1987 Prices	15
7	Distribution of Bayou La Batre Resident Shrimp Fleet by Loaded Draft July, 1986	16
8	Distribution of Total Shrimp Fleet Serving Bayou La Batre By Loaded Drafts Exceeding 10 Feet (July 1986)	17
8A	Biloxi Gage Tidal Data	20
8B	Shrimp Fleet Serving Bayou La Batre By Loaded Draft and Required Navigation Depths (those with loaded drafts over 10 feet)	22
9	Vessel Delay Costs October, 1986 Prices	24
10	Damages to Shrimp Vessels in 1986 by Vessels by Draft, October, 1986 Prices	25
11	Diver Costs by Vessels Drafts, October, 1986 Prices	26
12	Opportunity Costs to Labor, October, 1986 Prices	27
13	Costs Associated with Additional Travel Time, October, 1986 Prices	29
14	Existing Costs for Commercial Fishing Fleet Operations at Bayou La Batre, October, 1986 Prices	30
15	US Landings and Import of Butterfish (1978-1987)	35

LIST OF FIGURES

ECONOMIC APPENDIX
BAYOU LA BATRE, ALABAMA FEASIBILITY STUDY

INTRODUCTION

The purpose of this economic analysis is to establish the levels of national economic development benefit resulting from various modifications to the existing navigation channel at Bayou La Batre, Alabama. The existence of potential increases in the value of goods and services provided by channel users was initially established in a Reconnaissance Report, Survey Investigation for Navigation Improvements at Bayou La Batre, U.S. Army Corps of Engineers, Mobile District, February, 1985. The category and magnitude of these economic outputs have been more thoroughly defined and described in the following paragraphs.

The scope of this economic analysis includes an in-depth and detailed evaluation of the commercial fishing vessel operations, the ship repair and new vessel construction industry, and anticipated changes in seafood catch and processing and associated types of vessels using the Bayou La Batre channel. Data were collected through field interviews; formal meetings with local fishing/shipbuilding interests; and from published sources documenting vessel landings, operational characteristics and costs for vessels in Bayou La Batre, and demand and supply of various seafood species. This analysis includes a brief history of the study area; a description of the economic base; a definition of the problems and opportunities for channel users; and an evaluation of future benefits which may accrue with increased channel depths and other associated navigational improvements.

GENERAL

History of the Study Area. This small predominantly Catholic town is replete with generations of seafaring/fishing families who guardedly pass occupational knowledge and folklore down to their next generation. Located off Mississippi Sound in the extreme southwestern corner of Mobile County, Bayou La Batre is well isolated from other population centers in coastal Alabama. Indeed, historical records indicated such isolation was one of the prime reasons for initial settlement around the bayou. In 1786, Joseph Baussage petitioned the Spanish Governor of the Louisiana Holding for "a piece of land situated on Bayou Batre ...in order that he (and his wife and children) may live thereon undisturbed, and conceal from the eyes of the world his poverty and misery...". 1/ (The name Baussage has various modern spellings, including Bosarge and Bosage.) The petition was granted and Monsieur Baussage and his family established residency to fish and plant corn. Baussage, additional colonists and their contemporary descendents were not interested in pirating and smuggling as was Jean Baptiste or Sieur de Bienville, former governor of French Louisiana. When the latter retired from the governorship of Louisiana, he settled in Bayou La Batre in 1713. He built the battery of artillery for which the bayou is named, became a much-feared pirate and prospered from his clandestine ventures. Once coastal Alabama was opened to British and American settlers; fishing, livestock and later resort hotels became the important economic pursuits. At the turn of

the 20th century, however, fishing and seafood processing were predominant, with shipbuilding gaining importance from the time of World War I. 2/ (Shipbuilding has continued to grow, since the shipbuilder in Bayou La Batre (BLB) usually continues to own a fishing fleet in order to keep abreast of fishing technology firsthand.)

The commercial fishing fleet in Bayou La Batre is one of the most colorful, celebrated fleets in the U.S. Religion and customs of the area bring tourism from all over the U.S. each Spring to celebrate the beginning of each fishing season in an event called, "The Blessing of the Fleet." Over 400 decorated vessels parade the bayou each Spring awaiting their turn for the Archbishop of the Mobile/Birmingham Diocese to convey three (3) blessings upon the men and their vessel: safety at sea, good health, and a bountiful harvest of seafood.

Economic Base. From the time of incorporation in 1955, the city has had a relatively stable population. From a 1960 count of 2,572 persons, through 1970 with 2,664 to the 1980 decennial of 2,005 individuals, the degree of fluctuation has been minor, except for the late 1970's and early 1980's during which population out-migration occurred because of a slump in the oil exploration industry. Data sources for 1984 3/ indicated an increase in population to 2,162. With a land area of 3.0 square miles, or 22,368 acres, population density varies slightly also, averaging approximately one acre per inhabitant of Bayou La Batre. Distribution is a more accurate measure than density for showing settlement patterns. Not surprisingly, people have clustered along the bayou proper, which reflects its importance in their lives.

Table 1 portrays demographics of the population of Bayou La Batre in relation to Mobile County and the State of Alabama. There are no drastic differences between the three entities, except the fluctuations in the number of persons from 1970-1984 at Bayou La Batre. Table 2 gives characteristics about the housing available in the town. Owner-occupancy housing is more prevalent in the town than in the county or state, but the median value of this housing in the town is, not surprisingly, less than that of the county or state. Table 3 shows employment and income characteristics for the town, again, in comparison to the county and state. Of the town's population, 35 percent are employed, which is lower than that percentage for the county or state (31 percent are less than 18 years of age and 14 percent are 65 and older equalling 45 percent in these two categories). Therefore, 20 percent are either unemployed, work outside the city or are self-employed which may not have been ascertained by the source solicitors. Based upon MDO field data combined with the 1987-1988 Alabama Directory of Mining and Manufacturing, the employment in Bayou La Batre would seem to be higher than that shown in the latter sources in Tables 1-3. For example, the ten (10) largest wholesale seafood processors seasonally employ from 900 to 1200 (this excludes employment in another 26 small retail seafood houses); and the sixteen (16) shipbuilders employ 700 to 1,000 employees annually. These figures exclude employment in the marine related industries along the bayou (outrigging, net making, trawl board manufacturing, diesel fuel sales, etc.), self-employed crews of 504 vessels in the home-based commercial fishing fleet, and the self- employed crews/owners of the crab and oyster boats. Admittedly, the potential for double counting employment is high since a shipyard worker may crew a shrimp trawler during the two major shrimping

seasons, and may oyster and crab during these seasons additionally. A private consultant for the city (Galbraith & Associates) indicates that there are 4500 employed in seafood/shipbuilding industries in Bayou La Batre annually. An apparel manufacturer located at Bayou La Batre employees 500 employees annually 13/, which brings the total jobs available to 5,000 annually.

TABLE 1
Population for Selected Years and Population Characteristics of Bayou La Batre, Mobile County and the State of Alabama in 1980

Item	Bayou 4/ La Batre	Mobile 5/ County	State 4/ of Alabama
Population			
1984	2,162	378,800 6/	3,990,221
1980	2,005	364,980	3,893,888
1970	2,664	317,308	3,444,165
Percent Change 1970 to 1980	-24.7	15.0	13.1
Percent Black	9.6	31.56	25.6
Percent Spanish Origin	1.6	1.0	0.9
Percent Male	46.5	48.0	48.1
Median Age	29.1	27.8	29.2
Total Number of Families	517	94,386	1,038,881
% Married Couples 5/	78.9	77.9	81.4
% Female Householder, no husband present 5/	16.6	18.6	15.5

TABLE 2
Housing Characteristics of Bayou La Batre, Mobile County and the State of Alabama, 1980 7/

Item	Bayou La Batre	Mobile County	State of AL
Total No. Households	712	123,298	1,341,856
Percent Change 1970 to 1980	-9.6	34.4	29.8
No. persons per household	2.82	2.91	2.84
Total No. of Housing Units 8/	741	131,301 9/	1,450,011
No. Occupied Units	712	123,298 9/	1,341,856
No. Owner Occupied Units	502	81,377 9/	941,219
Value Owner Occupied 8/			
No. less than $20,000	139	NA	161,588
No. Over $50,000	46	NA	181,701
Median Value	$25,000	$37,500 9/	$33,900

NA = Not Available.

TABLE 3
Employment and Income Characteristics of Bayou La Batre, Mobile County and the State of Alabama 10/

Item	Bayou La Batre	Mobile 11/ County	State of Alabama
1980 Population	2,005	364,980 12/	3,893,888
Employment 1980			
Total No employed	702	142,825 12/	1,511,928
% of Population	35.0	39.1 12/	38.8
% in Manufacturing	15.0	20.0 12/	26.1
% in Wholesale/ Retail trades	30.0	22.0 12/	19.2
Income			
Per Capita in 1983	$ 5,527	$ 9,149 11/	$ 7,603
Median Family in 1979	$13,468	$ 17,354 12/	$ 16,347

PROBLEMS AND OPPORTUNITIES

The problems and opportunities in the study area are all related to the marine activities using the existing Bayou La Batre channel. Both the problems an opportunities are associated with operational and production inefficiencies for the commercial fishing fleet, shipbuilding industry, and other marine related industries. A more detailed discussion of the problems and opportunities within the Bayou La Batre study area are contained in the Main Report.

ANALYTICAL CONSTRAINTS

During field interviews, there incongruent opinions among the channel users concerning problems associated with use of the existing channel; e.g. it was necessary to carefully screen damages which occurred during vessel launch to determine if they were attributable to an inadequate launch area (shipbuilder responsibility) or to the channel depth. It was also an arduous process to ascertain operational patterns of the commercial fishing fleet, since the entire fleet is never assembled at any one time within the Bayou. Between fleet captains and seafood processors, reliable operational data were obtained about the entire fleet which would identify its operational patterns and operational costs. Minimum operational needs (underkeel clearances, probabilities of delays, etc.) had to be clearly understood by all interested parties and correlated with overall operations so that consistent reliable data were obtained. It was not uncommon to interview a channel user twice in order to make sure the data matched the operations of the fishing vessel or shipbuilder. Accordingly, the data herein accurately represents the operations of all industries on the Bayou and forms a valid base from which to analyze benefits.

Data on vessel damage and delays by vessel name are kept by two commercial operations within the Bayou. Other commercial firms only maintained these data as an aggregate cost for the fleets on an annual basis. No firms kept complete records of the exact time of damages, which would have allowed correlation to available tides and depths.

EVALUATION METHODOLOGY

General. All users along the channel were interviewed by MDO personnel. The users' costs and revenues were discussed, described, analyzed and categorized by industry. Descriptions of each industry are presented in the following paragraphs. An analysis of operational characteristics, costs, and revenues is also provided by industry and/or individual user (shipbuilder) where necessary. The economic costs are categorized by industry for the Existing Condition, Without-Project Conditions and With-Project Conditions. Benefits attributed to various channel deepening plans are those costs which are reduced or eliminated when compared to Without-Project Conditions. A sensitivity analysis was performed to address the effects of alternate future condition scenarios of channel use under the Without-Project Condition.

Change in Income. The basis for evaluating improvements to the existing federal channel at Bayou La Batre is the change in net income to users of the channel. For the commercial fishing fleet, this is the cost savings to harvest projected seafood landings. These savings are measured as the reduced cost associated with shorter and fewer delays, reduced damages, and increased opportunities to labor. For shipbuilders, cost savings are measured as reduced production inefficiencies attributable to increased depth availability (both in magnitude and duration).

THE BAYOU LA BATRE SEAFOOD INDUSTRY--EXISTING CONDITIONS

General. Bayou La Batre has a history of continued growth in the seafood industry. Over time, seafood harvesting and processing have been the primary source of employment and income to the area. Due to the overall efficiency of the seafood operations at the port, Bayou La Batre products are marketed throughout the world. According to the Alabama Sea Grant Advisory Service, a total of 57 seafood processors operate in Bayou La Batre or along the channel. Ten (10) major wholesale seafood processing plants in Bayou La Batre employed from 900 to 1,200 full-time and/or seasonal employees in 1986 14/. Seafood processing is the largest dollar volume and largest employment industry in the study area. In most cases, the owner of the seafood processing business is also the owner of a fleet of commercial fishing vessels -- the ancillary business which would offer diversity and increased annual incomes for the seafood processors. Also in most cases these seafood businesses are the second or third generation owners who are passing the technology to their children.

Magnitude of the Seafood Industry at Bayou La Batre. As shown in Table 4, Bayou La Batre was 29th in the United States' ports in 1986 in landings and 7th in the nation in value of catch. It should be noted that, of the top ten (10) ports in Table 4 which shows the largest quantity of fish landed, the top seven (7) are predominately "pet food" ports which is reflected by their relatively lower total landed value. Of the Gulf of Mexico ports, only two ports (Brownsville-Port Isabel, TX and Arkansas Pass-Rockport, TX) exceeded Bayou La Batre's total value of shrimp landings. Bayou La Batre is the largest volume seafood port in Alabama. Approximately 85% of the total quantity for the state of Alabama and 90% of Mobile County's total value of landings occur at Bayou La Batre.

TABLE 4

U.S. COMMERCIAL LANDINGS 15/

COMMERCIAL FISHERY LANDINGS AND VALUE AT MAJOR U.S. PORTS, 1984-86

Port	Quantity 1984	Quantity 1985	Quantity 1986
	- -Million Pounds- -		
Cameron, LA	679.2	673.6	616.8
Pascagoula-Moss Point, MS	425.3	423.2	365.5
Empire-Venice, LA	383.5	224.5	317.6
Intercoastal City, LA	(1)	(1)	298.9
Dulac-Chauvin, LA	327.2	398.6	294.6
Los Angeles, CA	237.0	150.3	187.4
Kodiak, AK	113.6	96.1	124.0
Gloucester, MA	179.1	116.5	110.0
Beaufort-Morehead City, NC	185.3	133.2	98.9
Dutch Harbor-Unalaska, AK	46.9	106.3	88.3
Petersburg, AK	54.1	(1)	85.2
New Bedford, MA	99.5	90.6	65.8
Point Judith, RI	69.9	56.8	52.1
Biloxi, MS	50.8	41.1	46.7
Bellingham, WA	34.0	38.8	45.9
Rockland, ME	42.9	58.6	43.2
Ketchikan, AK	(1)	(1)	42.2
Seattle, WA	60.3	42.2	38.2
Astoria, OR	23.1	25.5	36.8
Cape May-Wildwood, NJ	34.1	30.3	36.6
Portland, ME	37.0	36.1	34.9
Boston, MA	20.2	19.8	31.4
Port Hueneme, Oxnard, and Ventura, CA	9.4	19.9	31.0
Ocean City, MD	24.4	24.5	29.1
Wanchese-Stumpy Point, NC	28.1	22.7	27.2
Aransas Pass-Rockport, TX	25.2	24.2	27.1
Newport, OR	25.7	29.4	26.7
San Francisco Area, CA	22.4	31.0	25.9
Bayou La Batre, AL	18.2	21.0	25.6
Brownsville-Port Isabel, TX	23.0	22.9	25.5
Sitka, AK	39.8	(1)	25.2
Golden Meadow-Leeville, LA	16.2	18.2	25.1
Hampton Roads Area, VA	33.3	24.4	24.8
Coos Bay-Charleston, OR	20.1	25.6	24.3
Westport, WA	15.0	12.8	22.9
Atlantic City, NJ	28.8	21.9	22.0
Cresent City, CA	15.9	19.8	20.9
Eureka, CA	22.5	28.5	19.4
Delcambre, LA	8.6	7.7	18.7
Ilwaco-Chinook, WA	10.6	7.0	18.3
Fort Bragg, CA	12.7	16.0	17.8
Morgan City-Berwick, LA	(1)	7.7	17.4
Lafitte-Barataria, LA	12.5	20.6	16.8
Monterey, CA	30.3	18.2	16.4
Delacroix-Yscloskey, LA	10.8	11.0	16.3
Key West, FL	17.7	15.3	15.4
Blaine, WA	12.5	18.7	14.3
Grand Isle, LA	9.2	11.1	14.0
Chincoteague, VA	9.3	12.2	13.9
Santa Barbara, CA	10.1	10.7	13.7

Port	Value 1984	Value 1985	Value 1986
	- -Million Dollars- -		
New Bedford, MA	107.7	103.2	106.0
Dulac-Chauvin, LA	59.7	59.9	71.0
Kodiak, AK	69.9	65.8	70.2
Brownsville-Port Isabel, TX	51.0	49.6	69.3
Aransas Pass-Rockport, TX	51.1	43.0	60.3
Empire-Venice, LA	41.6	34.3	47.1
Bayou La Batre, AL	31.5	30.4	43.3
Golden Meadow-Leeville, LA	23.6	23.5	40.0
Petersburg, AK	24.9	(1)	38.1
Gloucester, MA	37.1	37.1	37.8
Dutch Harbor-Unalaska, AK	20.3	21.3	37.1
Cameron, LA	38.2	29.9	34.8
Port Arthur, TX	(1)	29.9	34.8
Los Angeles, CA	84.6	32.5	29.5
Bellingham, WA	14.9	16.6	28.8
Point Judith, RI	27.3	28.0	28.5
Delcambre, LA	14.3	12.7	28.4
Key West, FL	21.8	23.3	27.4
Freeport, TX	19.1	17.2	26.7
Beaufort-Morgan City, NC	21.6	22.7	24.7
Lafitte-Barataria, LA	24.1	29.0	24.1
Hampton Roads Area, VA	29.5	22.5	23.6
Portland, ME	14.5	17.2	22.4
Seattle, WA	16.5	18.7	21.8
Sitka, AK	26.8	(1)	21.8
Galveston, TX	20.1	13.4	20.9
Cape May-Wildwood, NJ	21.4	18.1	20.9
Ketchikan, AK	(1)	(1)	20.6
Pascagoula-Moss Point, MS	25.0	18.4	20.4
Boston, MA	11.2	12.1	19.1
Astoria, OR	9.2	9.5	16.4
Cape Canaveral, FL	26.2	21.2	15.9
Biloxi, MS	20.7	13.4	15.2
Newport, OR	9.5	12.8	13.5
Bon Secour-Gulf Shores, AL	11.5	10.2	13.5
Montauk, NY	9.7	8.9	12.8
Newport, RI	(1)	13.7	12.8
Atlantic City, NJ	14.4	11.9	12.7
Delacroix-Yscloskey, LA	10.8	10.6	12.5
Apalachicola, FL	13.2	12.4	12.4
Ocean City, MD	11.0	11.1	12.3
Wanchese-Stumpy Point, NC	10.8	13.3	12.3
Grand Isle, LA	11.0	12.4	11.9
Coos Bay-Charleston, OR	6.4	10.4	11.9
Fort Myers, FL	13.9	15.4	11.5
Westport, WA	6.6	9.8	11.3
Intercoastal City, LA	(1)	(1)	11.3
Blaine, WA	6.9	12.3	11.1
San Francisco Area, CA	9.2	12.5	11.1
Cresent City, CA	7.0	8.1	10.6

(1) Not available. Record quantity was 848.2 million lb landed in Los Angeles, California in 1950, and value $132.9 million in 1981 at Kodiak, Alaska.

NOTE:--Data for some ports are estimated. To avoid disclosure of private enterprise, Reedville, Va. is not included.

Based upon data from 1980-1986 in Table 5, the most valuable product landed at the Bayou was shrimp. During 1986, 14,500,000 pounds of shrimp were landed at the Bayou with an ex-vessel value of $36,700,000 ($2.53 average price per pound). In addition to the volume of shrimp being offloaded into the port by vessel, large amounts of seafood reach the port by truck. In 1986, over 28 million pounds of shrimp were transported by truck to Bayou La Batre for processing and wholesale distribution based upon information received from the National Marine Fisheries Service (NMFS) representative at Bayou La Batre. According to local interests, some of the shrimp are from foreign countries and are imported mainly through Miami, FL and New Orleans, LA. Some of the processors purchase domestic shrimp at other Gulf of Mexico and South Atlantic ports; also a small number of the Gulf boats based at Bayou La Batre offloaded their catch at other ports during the shrimping season and trucked their catch back to Bayou La Batre. From all these sources, 28 million pounds of additional shrimp were truck to Bayou La Batre by mainly wholesale processors who have control over the product during the entire catch, manufacture, and market sequence up to the time the product reaches the retail level of sale. In summary, approximately 42,500,000 pounds of shrimp was processed at Bayou La Batre during 1986. Applying the ex-vessel price per pound reported for Bayou La Batre to this quantity of shrimp yields a total value of $107,500,000.

TABLE 5
Shrimp vs Total Fisheries Landed At Bayou La Batre
1980-1986

Shrimp (Heads On) 16/	1980	1981	1982	1983	1984	1985	1986
Catch (Millions of lbs)	10.0	12.1	7.8	3.6	6.2	8.1	11.6
Value (Millions of $)	2.7	6.4	6.8	2.5	3.5	6.4	6.6
Avg $ per pound	0.27	0.53	0.87	0.69	0.56	0.79	0.57
Total Fisheries 17/							
Catch (Millions of lbs)	19.9	25.1	17.8	13.6	18.2	21.1	25.6
Value (Millions of $)	23.7	31.4	33.8	28.5	31.5	30.4	43.3
Avg $ per pound	1.19	1.25	1.90	2.10	1.73	1.44	1.69

According to the NMFS representative at Bayou La Batre, total earnings by specific product for all major processing houses at the Bayou in 1986 were as follows:

TABLE 5A

Seafood Earnings - Bayou La Batre - 1986

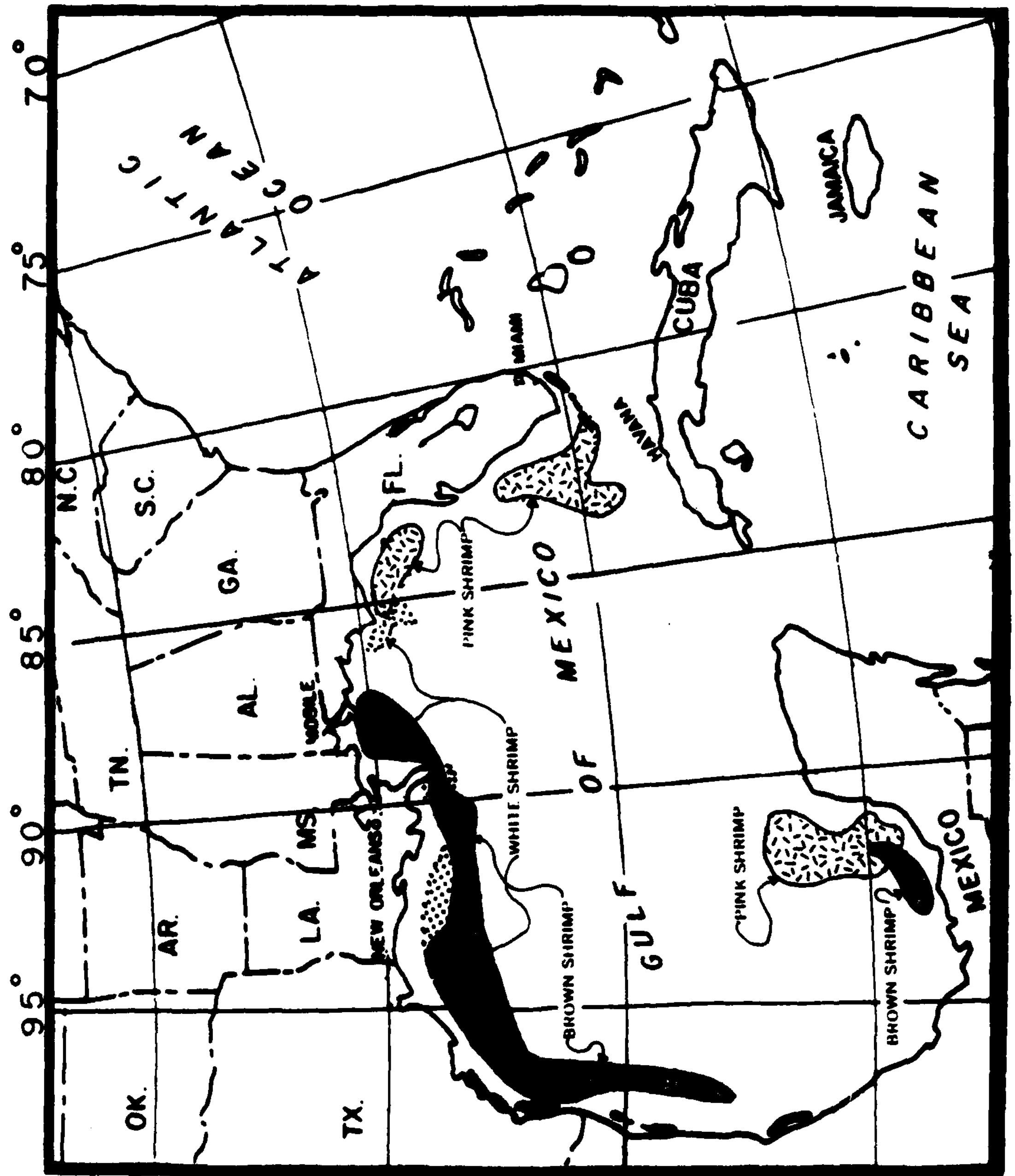
Product	Pounds	Value
Processed shrimp (heads off)	26,565,000 a/	$108,415,000
Oysters (8.75 lbs per gal.)	1,575,000	4,700,000
Picked Crab Meat	1,205,000	7,285,000
Misc.(Fish, Crabs, etc.)	737,000	2,318,000
Totals	30,082,000 b/	$122,718,000

a/ The conversion to heads on is 26,565,000 x 1.6 = 42,504,000 pounds.

b/ This figure will not match the data in Table 5 for 1986; these figures are the weight and value of seafood processed from supplies which have been trucked into and landed at the Bayou.

Habitat and Migration of Shrimp. The shrimp resource in the Gulf of Mexico consists of three species: brown shrimp (*Penaeus aztecus* Ives), white shrimp (*Penaeus setiferus* Linnaeus), and the pink shrimp (*Penaeus duorarum* Burkenroad). Areas of the Gulf where the adult shrimp of each species can be found depends primarily upon the type of bottom sediment. See Figure 1. The area from the Texas-Mexico border to just west of the Texas-Louisiana border consists of mainly sand and finer grain sediments and is inhabited by brown and white shrimp. The second area which extends east to Pascagoula Bay, Mississippi is mainly a complex of fine grain sediments, or mud, caused from deposition by the Mississippi River and is inhabited by brown and white shrimp. The third area begins with sand and shell in Alabama, and gradually becomes laden with coral at the southern Florida coast and is inhabited by pink shrimp.18/

Brown shrimp spawn in the Gulf of Mexico from November to April, at which time the larvae migrate to an estuary, such as Mobile Bay and Mississippi Sound. As they grow and mature into adults, they migrate back offshore from May to August. Peak months for largest catch are June and July. White shrimp spawn in the Gulf of Mexico from March to October. The larvae then migrate to the estuary between the months of May and October. The white adult shrimp subsequently migrate offshore between June and November. Peak months for largest catch are September and October. (Pink shrimp are not a readily available resource for the Bayou La Batre shrimper since the major pink shrimp grounds are off the tip of Florida and the Yucatan in the Gulf of Mexico.)



Source: National Marine Fisheries Service., 1972

FIGURE 1
SHRIMP GROUNDS IN GULF OF MEXICO

Generally, Mobile Bay is open to shrimping all year except from mid-April to mid-May of each year. The Gulf of Mexico is open to shrimping year-round. The brown shrimp season normally is during the summer months and the white shrimp season is in the fall of the year. The peak months are generally May through December for shrimping and all year long for fishing.

Annual Yield of Shrimp. Based upon historical catches of shrimp in the Gulf of Mexico over the last 26 years (Figure 2)19/, the annual catch trend has been increasing 1.99 percent annually. (Using the period 1976-1986 the growth trend drops to 1.91% per year.) Based upon the maximum probable catch (MPC) projections by the Gulf of Mexico (GOM) Fisheries Management Council, 345.6 million pounds of shrimp (heads on) are available for harvest annually in the GOM (the annual biomass is unknown).20/ This figure includes recreational (7.4%), bait (1.8%) and discard (3.7%) shrimp, or, 12.9 percent of the total available shrimp; therefore, the MPC available to the commercial fleet for harvest is 301.7 million pounds annually. As shown in Figure 2, 304.0 million pounds of shrimp were harvested by the commercial fleet from the Gulf of Mexico in 1986.

Other Fisheries. Generally, vessels engaged in harvesting oyster, crab, and other types of commercially sold fish do not require channel depths greater than 10 feet. Slightly less than 12 percent of the value of all landings at Bayou La Batre are for catch other than shrimp. Accordingly, the vessels engaged in the aforementioned fisheries are not a part of this analysis. Two exceptions to this statement are the butterfish and surimi industry which are discussed later.

Fleet Shrimping Patterns.

Figure 3 displays shrimp catches by area by month for 1986 for the entire Bayou La Batre fleet. These data were supplied by the NMFS office at Galveston, Texas based upon a grid system which differentiates inland waters from the open Gulf. The data are separated into those catches east, due south and west of the Bayou La Batre channel and are based upon the reporting of the total 1986 landings for the Bayou.21/ These data indicate that 66 percent of the catch was from open Gulf waters and 34 percent was from inland/bay waters.

It should be noted that there is a smaller catch during January through April for the fleet in Figure 3. The effort to catch ratio is dramatically increased during these months due to fewer shrimp being available and the shrimp are caught in deeper waters.

Reaggregation of these same data shown in Figure 3 indicates that 29 percent were caught in waters due south of Bayou La Batre which included the area in the Gulf from Mobile Bay to the west end of Chandelier Island off Louisiana. These data also showed that the remainder of the catches were proportioned to the western Florida Coast (5 percent) and to Mississippi and Louisiana waters (64 percent). (Landings from Texas waters amounted to 1.5 percent, and were caught just inside the Texas border).

Based upon Figure 2 which shows the most fertile shrimp grounds and Figure 3 which shows the catch by area by month, the movement of the Bayou La Batre fleet is quite evident. From January through May, the bay boats are

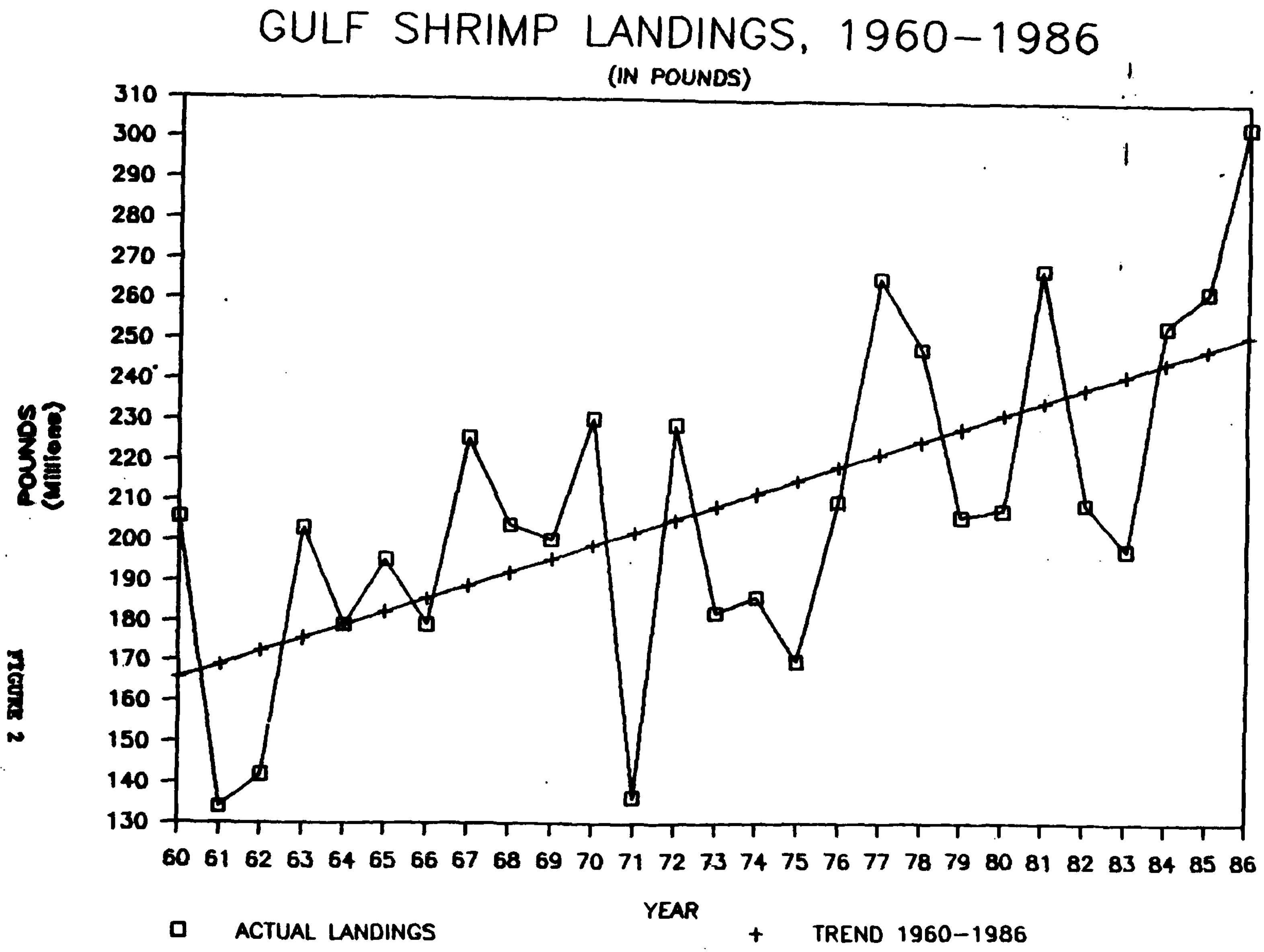

GULF SHRIMP LANDINGS, 1960–1986
(IN POUNDS)
POUNDS (Millions)
310
300
290
280
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86
YEAR
ACTUAL LANDINGS
+ TREND 1960–1986

FIGURE 2

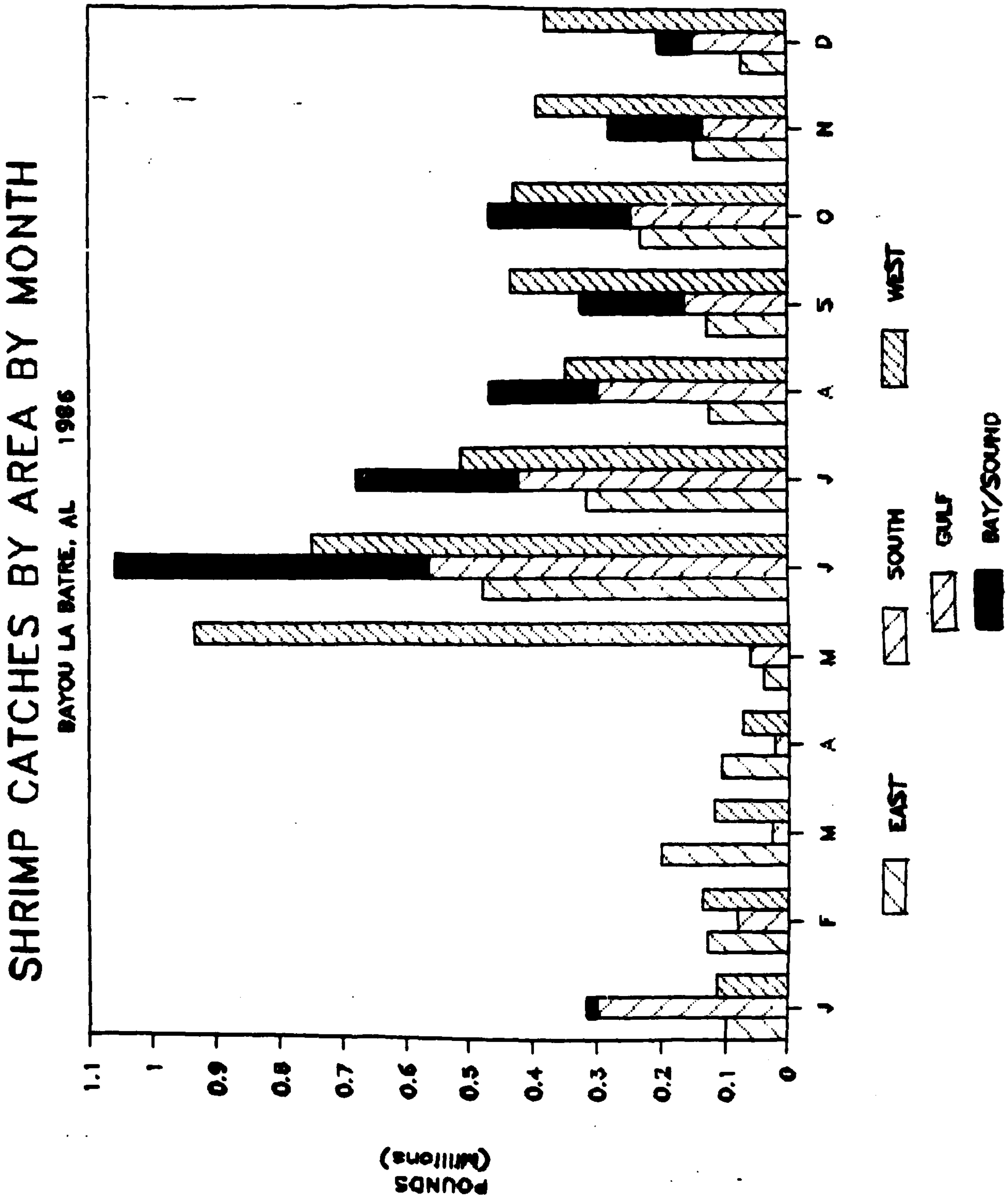

SHRIMP CATCHES BY AREA BY MONTH
BAYOU LA BATRE, AL 1986
POUNDS
(Millions)
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
J
F
M
A
M
J
J
A
S
O
N
D
EAST
SOUTH
WEST
GULF
BAY/SOUND

FIGURE 3

virtually idle, and the gulf boats are divided between offshore Florida but mainly offshore Louisiana until 15 May when the Louisiana brown season opens in inland waters. This attracts the majority of the Bayou gulf boats. By June, the brown shrimp season opens in the inland waters of Alabama and Mississippi which brings some of the gulf boats back to local waters, and it activates the bay fleet. During July through September, the distinction of a bay and gulf boat fades as both shrimp in both types of waters (bay/sound versus open waters). By October the white shrimp season opens along the entire Gulf Coast, and the gulf boats shrimp more along the Mississippi and Louisiana coasts October through December. While the white shrimp season is waning to a close in inland waters by mid-January, the bay boats are idled.

The Bayou La Batre gulf vessel rarely shrimps further than 8 hours in distance from home so that the vessel can return to the Bayou seafood processing houses to sell their catch and for crew rest. Prices paid in the Bayou are almost always higher than Louisiana prices. Higher prices are paid by Bayou seafood processors for two reasons: a) the owner must pay for trucking the catch back to the Bayou if landed in Louisiana which is a reduction in price to crew/captain; and, b) prices decrease in Louisiana when the inland waters of Louisiana open and the supply of shrimp is increased dramatically.

Vessel Trips and Operating Costs.

Based upon field data developed by District staff and by research consultants 22/ under contract to Mobile District, the larger shrimp vessels (loaded drafts 11-16 feet) make an average of 18 shrimping trips annually which are an average of 14 days each. Their average catch, gross revenues and average operating expenses are shown in Table 6. These figures are based on the operating expenses of a 12-foot loaded draft vessel, or, the most prevalent size vessel in the fleet.23/

TABLE 6
Average Annual Revenue and Costs Associated with Operating a Larger Shrimping Vessel Out of Bayou La Batre July, 1987 Prices

<u>Revenues</u>	
135,000 pounds of Shrimp @ $2.53 per pound (18 trips)	$341,550
<u>Variable Costs</u>	
Effort Expense a/	82,489
Catch Expense	
Crew Share (crew of 3; 26.6% of catch)	86,184
Captain's Share (12%)	38,880
Other Catch Expense b/	2,493
Total Variable Costs	$210,046
<u>Fixed Costs</u> c/	41,965
<u>Return to Management</u> (10% of Variable Costs)	21,005
Total Costs	$273,016

a/ Includes fuel, ice, engine repair and maintenance, general boat repair, gear repair and purchase, and marine hardware and supplies

b/ Includes groceries and other catch expense.

c/ Includes normal hull repair, interest, insurance, depreciation and other fixed costs.

Characteristics/Operational Patterns of the Bayou La Batre Commercial Fishing Fleet. The following paragraphs describe the Bayou La Batre fleet's physical and operational characteristics.

Sizes of Vessels:

Seafood processors and dealers at Bayou La Batre are supplied by vessels based at the port and by a number of transient shrimping vessels. According to data obtained in the 1986-1987 field survey, the resident vessels number 504 while the transient vessels number 100 or 604 vessels in total. Based on a tabulation of data submitted by local interests, the Bayou La Batre resident/permanent fleet was distributed as shown in Table 7.

TABLE 7
Distribution of Bayou La Batre Resident Shrimp Fleet
by Loaded Draft a/
July, 1986

Loaded Draft	No. of Vessels
2'-3'	186
4'-7'	50
8'-10'	135
11'-14'	132
15'-16'	1
Total	504

a/ Vessel lengths range from 25 to 100 feet; beams range from 10-28 feet.

The total fleet (resident and transient) can be divided into two classes which are determined by operational patterns and not necessarily by loaded draft: gulf boats and bay boats. Gulf boats make average 14-day trips, and bay boats make 4-day trips. Based on interview data the Bayou La Batre fleet is a 50/50 split between bay and gulf boats, and the transient fleet is all gulf boats. Therefore, the total Bayou La Batre gulf fleet was determined as 352 boats. The total bay fleet was determined to be 252 boats.

Vessels Requiring a Deeper Channel.

Vessels with fully loaded drafts of 10 feet or less can operate on the waterway with few difficulties and have been excluded from further analysis. Vessels having loaded drafts exceeding 10 feet can be expected to experience delays or damages due to insufficient channel depth during some time of the year. Based on field data supplied by seafood operators, there are approximately 142 vessels in this category which is comprised of 133 homebased vessels and 9 transient vessels. All of these vessels are gulf boats. The distribution of these shrimp vessels by loaded draft is shown in Table 8.

TABLE 8
Distribution of Total Shrimp Fleet Serving Bayou La Batre
By Loaded Drafts Exceeding 10 Feet
(July, 1986)

Loaded Draft	No of Vessels
11'	24
12'	101
13'	4
14'	12 a/
16'	1 b/
Total	142

a/ 9 of these vessels are from the transient fleet which operate more out of Bayou La Batre than out of their home port.

b/ This vessel cannot fully load at the Bayou; high tides are not available to support this draft.

Vessels Designs.

Almost all of the vessels operating out of the Bayou are constructed with steel hulls and have the following items which are located at or near the bottom of the vessel:

a. Transducer - located 6 inches from the outside bottom of the port side, is a device used for determining water depth and fish finding;

b. "Lister" Coolers - located 8 inches from the outside bottom on the starboard side, is a brand name for two small engines for battery charging and for auxiliary pumps (heat exchange) which are vented to the deck;

c. Engine (keel) Cooler - located 8 inches from the outside bottom on the starboard side, is a system of elongated pipes which circulate fresh water against the hull of the vessel for cooling the main drive of the engine;

d. Freon (keel) Cooler - located 8 inches from the outside bottom on the port side, is a system of elongated pipes which circulate fresh water against the hull of the vessel to cool the drive of the separate engine(s) for refrigeration system;

e. Sea Chest - located 0.5 to 1.0 inches from the inside bottom, is the sea water intake and pump system for water cooling systems of the main engine and refrigeration engine, a pump which provides for deck wash down, salt-water intake for condensing unit of refrigeration system, pump for crew bathing, etc. The opening to the sea chest is a small screened hole in the hull which must be kept clear from the channel bottom to avoid intake of sediment and other potentially clogging matter;

f. Roll Chock - located outside on both sides of the vessel from mid-bow to mid-ship, is a fin-like steel attachment which resists water when the vessel is exposed to side seas and lessens the roll of the vessel; the bottom of the roll chock protrudes 14 to 16 inches at 45 angels to the keel;

g. "Sat-Nav" System - located on the keel and protruding 3 inches below the keel, is a satellite navigation system which requires a speed log under the hull;

h. Kort Nozzle - a steel band around the propeller which is flush with the bottom of the hull, provides the engine with more thrust for pulling nets and more speed, but less maneuverability;

i. Propeller - located at the stern and flush with the vessel keel, is a system of blades which propel the vessel;

j. Shaft - located inside the center of the vessel, is a rotating rod which connects to the engine and the center of the propeller; and

k. Rudder - located at the stern of the vessel and below the propeller and flush with the bottom of the keel, is a vertical blade which changes the vessel's direction.

The keel coolers (engine and freon) can be of two types -- those fabricated by the shipyard, as an integral port of the hull but extending below the hull, or simply a system of steel pipes separate from but attached to the hull and located outside the vessel. The latter are more susceptible to damage. The bigger the vessel, the more systems (keel coolers) that are needed to provide water, air and heat exchange to properly operate the engines/systems of the vessel.

Susceptibility to damage for the items mentioned above depend on their proximity to the keel and their sensitivity to intake of the fluff and mud from the channel. This is of particular concern in the case of the intake opening to the sea chest.

INEFFICIENCIES BEING EXPERIENCED BY THE EXISTING COMMERCIAL FLEET.

Tidal Conditions and Vessel Operating Difficulties.

Tides at the Bayou are diurnal, which means that vessels with drafts requiring water surfaces above MLW have one (1) opportunity per day to catch high tide and safely exit or enter the channel.

This constraint inhibits vessel operations throughout the year. Peak brown shrimping season occurs during June and July; the peak white shrimp season occurs during September and October; and the season for the harvest of finned fish is all year, as is shipbuilding. Vessels are delayed, damaged, or both damaged and delayed, on both exit and entry to the Bayou channel.

Tidal data (which includes not only astronomical tide, but also the effect of wind conditions on these tides) were examined for 40 years of record at Pascagoula Harbor, Mississippi, Mobile Harbor, Alabama and for 12 years of record at Biloxi, Mississippi. Of these gage records, the one at Biloxi, Mississippi appeared most representative of conditions experienced at Bayou La Batre (where there is no gage record). The gage at Biloxi is located on the old Mississippi Highway 90 bridge inside the area of Mississippi Sound. This gage was chosen as a better indicator of tidal conditions (as effected by winds) at Bayou La Batre since it is much less effected by significant levels of riverine flooding.

A frequency analysis of the Biloxi gage data was made and is presented in Table 8A. The table shows data for the percent of gage time tides equalled or exceeded selected heights above Mean Low Water (MLW) (1-foot, 2-foot, and 3-foot). The existing channel at Bayou La Batre is maintained to a depth of 12-feet below MLW, therefore a tide equalling or exceeding 2-feet above MLW provides an available navigation depth of 14 feet. The frequency data is shown for the entire 12 years of record and is also shown compared to data computed for the year 1986 (portrayed as typical by local channel users). Inspection of Table 8A reveals some seasonality to the availability of tide heights above MLW, and seems to generally indicate the 1986 data shows higher tides than the average tides for the 12-year period. Although the season from about December through April shows as providing a lower frequency of tides over MLW, it should be pointed out that water surfaces of this type occur every month throughout the year. This seasonality shown in the data seems to substantiate the local channel users indications that during the winter and early spring months sustained northerly winds suppress normal astronomical tides (both high and low).

Using tidal data from the Biloxi gage for the year 1986 (taken as a representative year) a graphic analysis of available depths at Bayou La Batre was made and is presented in Figures 4-15 at the end of this Appendix. Shown in these figures are a plot of actual (astronomical plus wind effects) tide for each day of each month through one full year. Also shown plotted in relation to the tidal heights are (from bottom to top): a line representing the channel bottom (at -12 foot MLW or -12.5 foot NGVD); a line representing MLW (at -0.5 NGVD); a line representing the tidal datum of zero NGVD; and several other lines representing increments of 1, 2, and 3 feet above MLW (or navigation depths of 13, 14, and 15 feet respectively).

TABLE 8A
Biloxi Gage Tidal Data

Percent of Time Tides Equalled or Exceeded Indicated Heights Above MLW*

	For Tides 1 ft above MLW		For Tides 2 ft above MLW		For Tides 3 ft above MLW	
	12 Years (%)	1986 (%)	12 Years (%)	1986 (%)	12 Years (%)	1986 (%)
January	93.5	83.9	26.5	19.3	1.3	0
February	82.1	85.7	30.6	50.0	3.9	0
March	88.3	100.0	38.1	41.9	7.6	3.2
April	94.6	100.0	40.8	70.0	3.4	0
May	98.1	100.0	60.6	80.6	8.2	19.4
June	99.6	100.0	62.2	70.0	8.8	13.4
July	97.9	96.8	48.1	51.6	4.2	0
August	97.3	94.4	46.0	61.1**	4.8	0
September	98.7	100.0	69.5	86.7	7.7	10.0
October	95.6	96.8	52.5	80.6	11.5	19.4
November	95.2	93.3	62.0	73.3	13.9	16.7
December	90.8	94.4	52.1	77.8**	5.6	0
Yearly Average	93.1	-----	55.2	----	6.9	----

* A depth of 2 ft above Mean Low Water (MLW) provides a navigation depth of 14 feet (12 ft below MLW + 2 ft). A water surface of 1.5 NGVD equals 2 ft above MLW.

**Gage inoperative for part of the month; percent was based upon days operative.

Source: U.S. Army Corps of Engineers, Mobile District, Hydraulic Data & Sediment Section (from USGS gage at Biloxi, Mississippi).

Inspection of the plots for each month reveal not only the high frequency at which a vessel could encounter inadequate navigation depths (both leaving or entering the Bayou), but also lengthy periods of consecutive days in which tides never reach the require height for vessel operations. Looking at Figure 4 (the first plot for the month of January 1986) and the line representing a 14 foot depth (or 2-foot above MLW), it is very obvious that vessels requiring this height of tide would incur serious problems.

Underkeel Clearances.

Information from shrimp vessel operators and consideration of wave conditions and vessel characteristics (squat, pitch, roll, and trim) indicate that in addition to the loaded vessel drafts, one foot of depth is necessary to avoid banging the channel bottom u[illegible]rmal operating conditions. Ideally the operators of larger vessels [illegible]-foot loaded drafts and greater) prefer an additional foot of safety clearance (although not all operators at all times navigate under such a constraint). Combining these two requirements yields a total 2-foot underkeel, which also satisfies a need of additional depth over draft for maneuverability and avoidance of clogging water intakes on the bottom of the hull.

Most of the larger vessels in the Bayou are steel hulls with kort nozzles (circular steel plates around the propeller). These kort nozzles provide less maneuverability in shallow depths than traditionally powered vessels, but provide increased vessel speed and thrust for the same amount of fuel consumption. With an additional 2-feet below the keel (and kort nozzle) maneuverability is relatively the same as a traditionally powered vessel.

Vessel operators and shipbuilders also indicated that underkeel clearances of 2-feet are needed to avoid damaging systems which are located on the bottom of the hull (as previously described), but most importantly to avoid sucking silt or sand into the sea chest intake and seriously damaging the engines and refrigeration system.

The 2-foot of underkeel is desirable for all the reasons stated above and is consistent with Corps Guidance as stated in EP 1105-2-45, dated 6 August 1984; but a minimum of 1-foot is absolutely necessary under normal seas to avoid consistent vessel damage. With a 1-foot additional depth below the loaded draft, damage can still occur to vessel systems under abnormally rough conditions. Shown in Table 8B is a listing of the shrimp fleet by loaded draft, required and desirable navigation depths (with underkeel clearances considered).

TABLE 8B
Shrimp Fleet Serving Bayou La Batre
By Loaded Draft and Required Navigation Depths
(those with loaded drafts over 10 feet)

Loaded Draft (ft)	No. of Vessels	Navigation Required (1-ft underkeel)	Depths Desirable (2-ft underkeel)
11	24	12	13
12	101	13	14
13	4	14	15
14	12	15	(16)*
16	1	(17)*	(18)*

* With the existing channel and available high tides, these depths are never available at Bayou La Batre. The 16-foot loaded draft vessel cannot fully load when operating in the Bayou.

Consideration was given to the development of a risk-cost curve for vessel operations at the Bayou, which would attempt to show changes in income and operating costs as underkeel clearance is decreased and risk of vessel damage is increased. This type of analysis is performed to establish an "acceptable operational" underkeel clearance where risk-cost and income are balanced through light loading by vessel operators.

However, this curve could not be developed for vessels operating out of the Bayou for two reasons: (1) the vessel operators fully load (on exit and entry) and (2) no data exists on each vessel in the Bayou which would show correlations between the actual hours of delay, damage, and the date and time navigations are attempted. Without the date and time of incidents of damage, the exact tidal conditions, and therefore available underkeel clearances, can not be established.

Categories of Inefficiencies (Costs). Operational inefficiencies being experienced at Bayou La Batre are resulting in draft related costs in four categories: vessel delays, vessel damages, increased labor costs (opportunity cost of labor), and increased travel time.

a. Vessel Delays.

Field data indicated that the gulf vessel is equally weighted on exit and entry (fuel and water are decreased and catch is equally increased). Loaded drafts upon exit or entry, therefore, are essentially the same when the vessel captain is weighing the risk of navigating the channel on less than high tide. When trips occur during peak shrimping season, the monetary incentive to exit the Bayou hurriedly often overrides the known risk of damages to the vessel. The reverse would be true with the vessel loaded with shrimp upon returning to the Bayou. As can be seen from the daily tides in Figures 4-15, peak shrimping seasons have numerous occasions with consecutive days when tides are not available to safely navigate the channel. To catch a high tide with water sufficiently above MLW requires a timed return to port or a delay in leaving

(both are a delay). The ability to time returns is also impacted by the fac that the length of time to fill the vessel with catch is different on every trip for every type vessel (i.e. there is no standard trip duration for any one selected vessel).

Field data also indicated that all shrimping vessels with loaded drafts of 11 feet or over incurred about 120 hours of delays annually and these delays were more frequent during the November through February time frame because of the more frequent number of occurrences with 2 or more consecutiv days of depressed high tides. Each vessel makes an average of 6.5 trips during the winter months. The largest vessels (14-16 foot loaded draft) incurred delays of about 18.5 hours for each trip during these periods of consecutive days without tides high enough to navigate the channel safely. Since the tidal change is usually equally distributed over 12 hours, these tidal changes can be directly related to delays based on the draft of the vessels. For example, the 14 foot loaded draft vessels incurred an average 18 hours delay each fishing trip (either exit or entry but not necessarily both) based on the absence of high tides. Therefore, a 13-foot draft vessel incurred 75 percent of the 18-hour delay, a 12-foot draft vessel incurred 50 percent of the 18-hour delay, etc. The economic costs of these delays were determined from the total variable operating costs per hour for the vessels, excluding the crew and captain's share. Based on the cost shown in Table 6, the variable costs are $84,982. As stated previously, the vessels make 18 trips per year lasting 14 days each. Based on multiplying the vessel trips per year (18) by the trip duration (14 days), the yearly activity level per vessel would be 6,048 hours. The delay costs of $14.05 per hour is derived t dividing the yearly variable costs ($84,982) by the number of activity hours per year (6,048). The computations of delays for each vessel draft are showr in Table 9.

TABLE 9
Vessel Delay Costs
October, 1986 Prices

Draft	No. of Vessels	Hour Delays Each Trip	No. of Trips a/	Total Hour Delay	Delay Costs Per Hour	Total Delay Costs
11	24	4.5	6.5	702	$14.05	$ 9,863
12	101	9.0	6.5	5,909	14.05	83,014
13	4	13.5	6.5	351	14.05	4,932
14	12	18.0	6.5	1,404	14.05	19,726
16 b/	1	18.0	6.5	117	14.05	1,644
Total						$119,179

a/ Throughout the year, but mainly during winter months.

b/ The 16 foot draft vessel was added to this data in February, 1987 (no data available on its operating costs, since it is a freezer processor); therefore, the data in Table 8 was used as a proxy.

b. Vessel Damage Costs.

Although damages occur throughout the year, occurrences of consecutive days without appropriate depth are more frequent during winter months due to astronomically normally lower low tides and sustained northerly winds which suppress both high and low tides. The occurrence of damages and delays to the vessel fleet is spread throughout the year, but are more intense during peak shrimping season. This is due to more frequent use of the channel and competition between vessels to maximize fishing time. It should be noted that the damages discussed below are in addition to the delays previously described. Damaging a vessel (especially when a propeller or shaft is involved) also results in delays. When a vessel operator has timed the return to port, but misinterprets the available depth, damages and delay both occur. The vessel was delayed by a slower timed arrival at port; and due to impatience or misinterpretation of available depth and wave effects, incurs damage also.

Based upon information obtained from vessel operators in [illegible] the larger vessels sustained damages to shafts, propellers, rudders, hull [illegible] number of the aforementioned systems at/near the bottom of the vessel while using the Bayou La Batre channel. Of these, [illegible] vessels incurred damages averaging $4,800 each. One (1) 14 foot draft vessel incurred $1[illegible],000 in damages to its main propeller rudder and extensive damages to its hull. Two (2) of the 14-foot vessels also incurred consistent, monthly damages. The remaining 31 vessels incurred damages averaging about $2,600 each. Total repair costs in 1986 were $420,300, which are displayed in Table 10.

TABLE 10
Damages to Shrimp Vessels in 1986 by Vessel Draft
October, 1986 Prices

Draft (ft)	Number of Vessels	Average Damages Per Vessel	Total Damages
11	19	$ 2,405	$ 45,700
12	66	4,771	314,900
13	2	1,000	2,000
14	9	3,300	29,700
14	2	7,200 a/	14,400
14	1	10,000 a/	10,000
16	1	3,600 a/	3,600
Totals	100		$420,300

a/ Includes diver costs.

The likelihood of simultaneous damages and delays for a 12-foot loaded draft vessel (the prevalent size in this fleet) is further discussed. Based on the tide data in Figures 4-15, there were 36 occurrences in 1986 in which a 12-foot loaded draft vessel with a 2 foot underkeel clearance had to wait 12 to 168 hours to exit or enter the channel. Being fully loaded at exit (ice, fuel and supplies at exit are replaced with catch on re-entry), the vessel would wait a minimum of 12 hours which are the exact hours of the trough between the window of transiting opportunity of a decreasing peak diurnal high tide of one day to the same window of an increasing peak high tide on the next day, assuming no astronomical interference with peaks (northerly winds, etc.). At this point, the vessel has now been delayed a minimum of 12 hours; e.g., the depressed tides could last for several days. If the vessel captain reacts imperfectly to an imperfect weather forecast (sudden northerly winds with an already decreasing tide) and tries to exit, the vessel also incurs damages of the magnitude mentioned in Table 10. This risk-taking behavior of the captain becomes more acute upon re-entry back into the channel with the vessels' catch.

c. Diver Costs.

Based on field data collected in 1986, a number of the larger shrimp vessels have required professional divers to free propellers, check for hull damages and repair the vessel when necessary. Vessels drawing over 12 feet have incurred diver costs of about $45,000 dollars annually in total. Table 11 below indicates the reported diver costs for the various vessel drafts.

TABLE 11
Diver Costs by Vessel Drafts
October, 1986 Prices

Draft (ft)	Cost
11	--
12	$43,500
13	2,700
14	(see Table 10)
16	(see Table 10)

d. Opportunity Costs to Labor.

Opportunity costs to labor are "lost earnings" and are based on the average hourly wages the crew actually receives while shrimping. When a vessel is delayed, the captain and crew must work additional hours to receive the same annual salary. If the crew and captain were not being delayed, they have the opportunity to engage in other work. The value assigned to the other work is the same as the actual wages they receive on an hourly basis while shrimping. The value per hour for this time is based on the wages shown in Table 6 ($125,064) divided by the [illegible]ished annually (6,048, or 18 trips x 14 days each x 24 hours per day). [illegible]omputation results in an estimate of lost hourly wage of $[illegible]0.68 based on th[illegible] captain's and the crew's shares of the catch. Total hours delayed are those shown in Table 12, which indicates the benefits [illegible]reditable to this categ[illegible]y for each vessel draft.

TABLE 12
Opportunity Costs to Labor
October, 1986 Prices

Draft	Hours Delay a/	Value Per Hour b/	Value of Lo Opportuniti
11	702	$20.68 c/	$ 14,51
12	5,909	20.68	122,19
13	351	20.68	7,25
14	1,404	20.68	29,03
16	117	20.68	2,42
Total			$175,42

a/ See Table 9.

b/ Based upon the average of all vessels in this fleet.

c/ Includes crew and captain.

e. Additional Travel Time Via Petit Bois Pass.

Shrimp vessel operators traveling from Bayou La Batre to the open Gulf to shrimp directly south of Bayou La Batre prefer to use Petit Bois Island Pass since it is a shorter, more direct route. However, a shifting channel coupled with winds and strong currents have created unsafe operations for the larger vessels. Based on data submitted by vessel operators, Petit Bois Pass is unusable 70 percent of the time. In the absence of a safe passage through Petit Bois Pass, vessels must transit the Gulf Intracoastal Waterway and operate through either Horn Island (Pascagoula) Pass or Mobile Pass to travel to shrimp grounds directly south of Bayou La Batre. The vessel operators state that the use of either Pass represents an additional travel time of 1.5 hours per trip or 3.0 hours per round trip. The time spent operating via the alternative routes represent an inefficiency in vessel operation. While all vessels have some difficulty operating through Petit Bois Pass, vessels with loaded drafts in excess of 11 feet risk running aground with probable loss of catches, vessels and lives. Table 13 presents the costs associated with these additional travel times by vessel draft.

TABLE 13
Costs Associated with Additional Travel Time
October, 1986 Prices

Loaded Vessel Draft	No. of Vessels	Additional Travel Time Hours	No. of Trips a/	Total Hours b/	Total Cost Per Hour c/	Additional Travel Costs
11	24	3	5.2	374	$34.73	$12,989
12	101	3	5.2	1,576	34.73	54,734
13	4	3	5.2	62	34.73	2,153
14	12	3	5.2	186	34.73	6,495
16	1	3	5.2	16	$34.73	556
Totals	142					$76,927

a/ Adjusted to reflect possible use of Petit Bois Pass while shrimping due south of Bayou La Batre (18 trips yearly x 29% = 5.2). Otherwise, the vessel is headed due West or East, and Petit Bois pass affords no savings in distance traveled.

b/ Rounded.

c/ Fixed and variable operating costs.

Summary of Existing Condition Operational Inefficiencies. Table 14 below summarizes the total additional operational costs for the gulf fleet at Bayou La Batre using the existing 12 foot channel (12 ft below MLW).

TABLE 14
Existing Costs for Commercial Fishing Fleet Operations at Bayou La Batre

October, 1986 Prices
($1,000)

Categories	Existing Costs (12')
Vessel Delays	119.2
Opportunity Costs to Labor	175.4
Vessel Damages	420.3
Diver Expenses	46.2
Additional Travel Time Via Petit Bois Pass	76.9
Totals	838.0

INEFFICIENCIES IN EXISTING BUTTERFISH FLEET OPERATIONS

General. For several years National Oceanographic and Atmospheric Administration (NOAA) and its fisheries research arm, National Marine Fisheries Service (NMFS) investigated the biomass and migratory patterns of butterfish (*Peprilus burti*) in the northern Gulf of Mexico for export and development of US markets. There is an established butterfish industry on the Atlantic coast of the US; butterfish have previously been considered a "trash" fish by Gulf fishermen; however, it is a highly valued species on foreign markets. (All underutilized species of fish in US waters are under study by applicable geographical fishery management councils to determine their potential development for domestic and foreign consumption.) During the fall of 1984 and Spring of 1985, NOAA's research vessel, "Chapman" and the Japanese research vessel, "Nisshin Maru" combined exploratory, cooperative efforts to trawl for butterfish in the Gulf. The results were surprisingly good. Based on their findings, the Spring season produced greater quantities of butterfish than the Fall season (up to 10 metric tons per hour).

By Spring, 1986, a joint effort between New England fish cooperatives, which own large freezer-processor vessels, and three (3) modified Gulf shrimp trawlers (one owned by Deep Sea Foods, Inc. of Bayou La Batre) further tested the viability of initiating and developing a butterfish industry on the northern Gulf of Mexico. These efforts produced predictions by NMFS that this industry would be extremely profitable. The projected annual income from butterfish found in the Gulf would be $19,000,000 in ex-vessel value, or an annual export value of $75,000,000 when sorted by size, packaged, frozen and shipped to Japan. 24/ There is an incentive for the seafood processor who owns the vessel to own the butterfish all the way to the Japanese markets, since large salted and dried butterfish during 1986 sold for $15 per pound in Japan. This was the strong incentive for the three (3) Gulf vessels to conduct the aforementioned tests. These vessels are minimum 12-foot loaded drafts plus another foot of squat from filling all holds with seawater-ice slush. This butterfish fleet used an alternative port, Pascagoula, Mississippi, to land their catch since adequate depths were available and guidance from the NMFS butterfish research team was located at Pascagoula.

Projected Annual Volumes of Butterfish. Research data from NMFS indicate that the projected biomass of butterfish in the northern Gulf ranges from 34,000 to 124,000 metric tons. The projected yield from this biomass could be as high as 47,000 metric tons annually. 25/ This projected annual yield could attract many transient vessels to the Gulf, since... "butterfish landings in 1984 from Maine to Virginia [an established industry] totaled 11,270 metric tons with a value of $6.62 million dollars. Potential for production in the northern Gulf of Mexico, is three to five times this figure, according to Andrew Kemmerer, director of National Fisheries Service Mississippi Laboratories at Pascagoula."26/ The biomass of butterfish in the Atlantic is 16,000 metric tons based upon data from NMFS officials at Pascagoula.

Butterfish Vessel Characteristics and Fishing Grounds. These vessels were freezer-processors with rigging which allow fishing up to 170 fathoms of water with processing and freezer capacities ranging from 100,000 to 300,000 pounds. The five (5) New England stern trawlers which participated in the above tests in 1986, ranged in sizes from 90'-140' in length, 26'-32' in breadth, 15' in loaded drafts, and freezer-processing capacities of 100,000 to 300,00 pounds. Generally, their processing equipment could sort the butterfish into four (4) sizes (super small, small, medium and large) and package the fish into "swim" packs of various size boxes depending on time between haulups. If time did not permit sorting between haulups the butterfish were "swim" packed without sorting (the older, less modern freezer processors were more apt to have slower, less accurate sorting equipment). The packaged butterfish were flash frozen and stored in the large freezer room aboard ship.

Three (3) Gulf shrimp trawlers with applicable modified rigging also participated in the Spring, 1986 test; dimensions of these averaged 90'-100' in length, and 12'-14' loaded drafts plus one extra foot of squat from filling all holds with seawater-ice slush and catch. Their catch was held in ice slush and sorted after docking.

The fishing grounds are located along and north of the 100 fathom contour in the GOM almost directly south of Mobile and Pensacola Bays (see Figure 16).27/ Bayou La Batre is strategically located for entry into and expansion of the butterfish industry.

Total and Average Catches (1986-1988). Based upon data from NMFS, Pascagoula Office, these eight (8) vessels fished May 7 through July 15, 1986. During May the vessels oriented themselves to the fishing area which had been identified by the joint US-Japanese venture (Figure 16). The average catch was 80,050 pounds per 8.67 days for 1986, which was their average trip length. The total catch for this first operation (1986) was 1,305,155 pounds. The 1988 season was highly successful (6 New England freezer processors and 10 converted Gulf trawlers of which one was from Deep Sea Foods, Inc.). Catch rates doubled/tripled, and the number of trips were six-fold, and trips were shorter in duration. See the Confidential addendum to this appendix for details of the sensitivity of Japanese prices for butterfish to their knowledge of US supplies of butterfish.

Possible Use of an Alternative Port. During both seasons (1986 and 1988), Deep Sea Foods, Inc. tried to use the Port of Pascagoula to land their butterfish catch since adequate depths do not exist at Bayou La Batre without light loading the vessels, and encountered the following operational problems at Pascagoula, which either or both precluded their use of this alternative port:

a. Dockside processing facilities were completely inadequate for processing the butterfish (some of the fish were sorted and swim packed, some were split, gutted and sideways packed, etc.) for meeting Japanese marketing demands of freshness and quality; and

b. Only one public freezer storage facility (a bonded warehouse) was available for storing and staging each catch for several months before increased demand in Japan brought the desired price for their butterfish (one private freezer storage facility would purchase the butterfish at dockside prices which was not suitable to Deep Sea Foods, Inc.). At the public facility (Port Authority of Jackson County), wharfage (docking) was charged the vessel, stevedores had to unload the vessel and bonded personnel only could stage the butterfish by size (small, medium or large) for sale in container loads. The freezer processor vessels could use this public storage facility since their catch was processed at sea.

The converted trawler of Deep Sea Foods, Inc. started the 1988 season in mid-July and will fish possible until late November (peak season was predicted to be February to May in 1985/1986). Fully loaded, the vessel is expected to haul 50,000 pounds; light loaded 1 to 1.5 feet, the catch will decrease by 7,000 to 10,000 pounds (with light loading 1.5 feet, the vessel has incurred extensive delays and some damages and diver costs in 1988). Seven (7) trips have been made in 1988 with lengths of 2 to 4 days each with excellent catches, and the company does not yet have adequate vessel operating data to compute average operating costs for an average trip (catch) during the 3 seasons (spring, summer and fall) in order to assess the costs of operating the vessel light loaded. However, based on prices paid for export U. S. butterfish (see Table 15) during the period 1981-1987 ($.857), the costs for light loading could be substantial ($1,028,400) assuming annual trips of 120 (10 months/2.5 days per trip) with 10,000 pounds per trip light loaded.

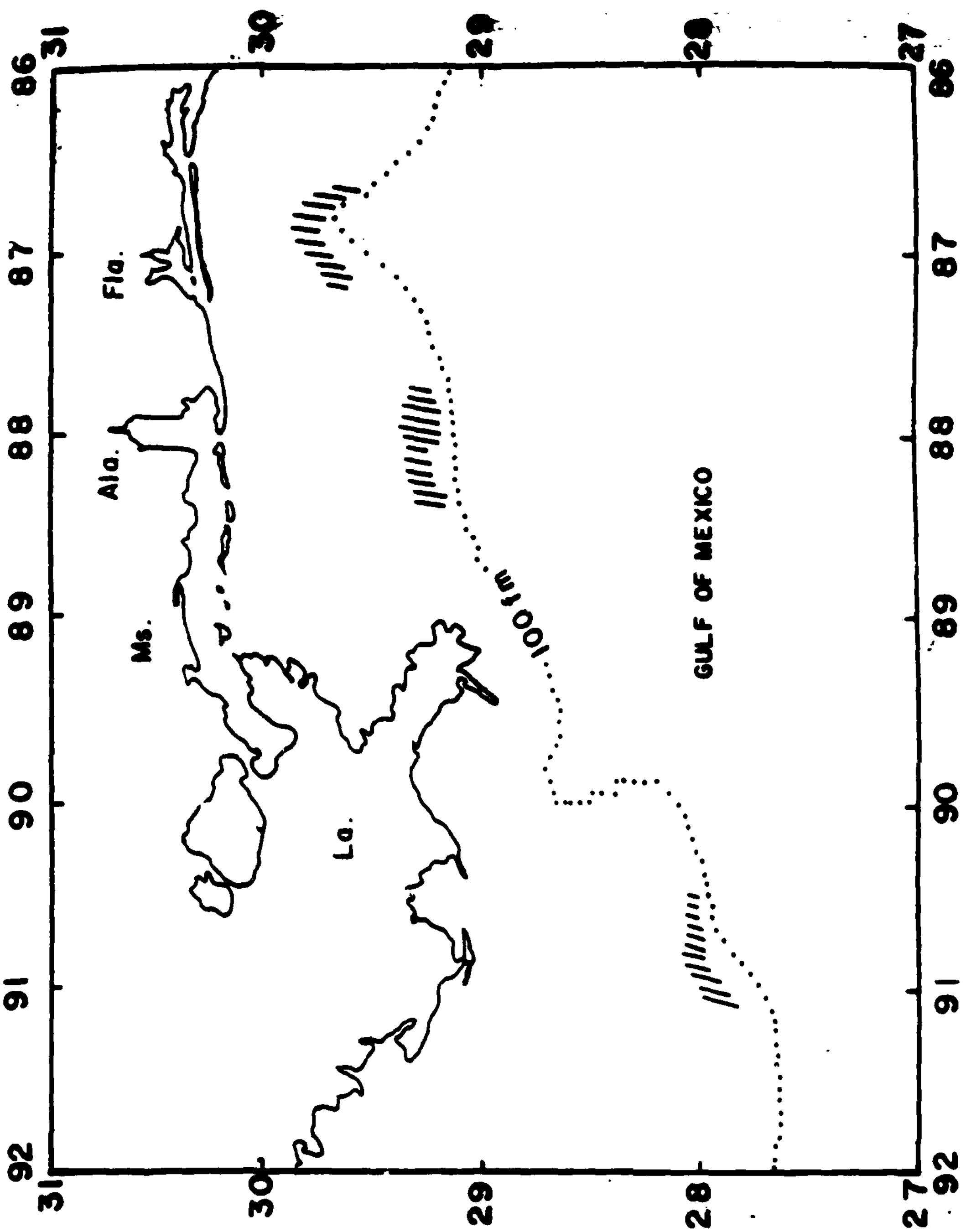


FIGURE 16
Butterfish Grounds in Gulf of Mexico

Source: Commercial Vessel Activities, Technical Memorandum on 1986 Inital Commercial Butterfish Venture in the Northern Gulf of Mexico (DRAFT), NOAA, NMFS, Pascagoula, MS, February, 1987.

Table 15
US Landings and Export of Butterfish (1978-1987)

	Million lb.		$ Price/lb.	
	Landings	Exports	Ex-Vessel	At US Port a/
1978	8.1	5.3	0.36	0.66
1979	6.1	0.4	0.34	--
1980	11.6	9.8	0.33	--
1981	7.8	4.4	0.33	0.70
1982	17.7	13.9	0.32	0.74
1983	10.6	4.8	0.31	0.82
1984	26.0	16.6	0.27	0.69
1985	10.3	n/a	0.34	--
1986	9.9	2.2	0.67	0.81
1987	10.3	7.6	0.63	1.38

a/ Value at US export port, based on selling price excluding inland freight, insurance and other charges.

Source: Gulf & South Atlantic Fisheries Development Foundation, Inc.

Bycatch of Other Species. Several highly marketable species of fish (herring, squid, scad, tuna, etc.) are also being caught in the butterfish nets and are being processed, packaged and marketed from Deep Sea Foods, Inc. As of June, 1988, this company has sold foreign and domestic consumers several thousand pound of these new species in processed form.

Summary of Costs. During 1986 and 1988, Deep Sea Foods, Inc. has landed several hundred thousand pounds of butterfish at Bayou La Batre on light loaded converted trawlers at unknown additional costs to this channel user. Therefore, since the butterfish industry is in a testing phase, additional costs for butterfish operations at Bayou La Batre for Existing Condition is not available. See data presented in previous paragraphs, and see Confidential addendum to this appendix for the reasons for non-disclosure of related data.

INEFFICIENCIES IN THE DEVELOPING SIMULATED SEAFOOD INDUSTRY

General. Simulated seafood, or "surimi," is a block of pure fish protein in jell (frozen) form, which can be processed into a shrimp-, crab-, scallop-, or lobster-flavored product with the addition of meat from other shellfish species. Atlantic croaker (*Micropogonias undulatus*) and white trout (*Cynoscion arenarius*) were expected in 1986 to comprise the largest portion of the raw materials required in this new industry on the Gulf Coast. This process is a Japanese invention; the potential for consumption in the U.S. is quite high. For example consumption in the U.S. has risen from 9.0 metric tons in 1979 to 40,000 metric tons in 1984, all of which was imported from Japan. 28/ Acceptance of this product in the U.S. is expected to accelerate rapidly which will provide opportunities for increased revenues for the seafood industries in the U.S.

Simulated Seafood Industry at Bayou La Batre. In 1980, Deep Sea Foods, Inc. of Bayou La Batre created a separate corporation, Nichibei Fisheries, Inc., as a research group which conducted a pilot program to develop surimi in the U.S. The program continued for 5 years with technical assistance from California and Japanese interests and under the direction of the NMFS (as a joint venture between Deep Sea Foods Inc, Deep Sea International Inc, and JAC Creative Foods of Los Angeles, California). The products were tested in Japanese markets and passed their standards for excellence. As a result of these efforts, a major U.S. surimi production corporation has been formed between Deep Sea Foods, Inc. and its Japanese corporation called JAC Creative Foods of Los Angeles, California. Deep Sea Foods, Inc. built a new surimi processing plant at Bayou La Batre at a cost of $2,000,000 in late 1987 which has a 24 million pound processing/freezing capability annually. This plant was partially operational in 1987.

Projected Operational Characteristics. The plant owners projected in 1986 that one-half the plants' production would come from pure surimi protein jell imported from Japan which would be trucked from their Los Angeles plant and flavored with products (shrimp and crab) caught and landed at the Bayou. The other 12 millions pounds of surimi would be produced from raw materials (fish) caught in the Gulf in the freezer processors to be used in the butterfish industry. By June, 1988, the preliminary testing of the Gulf species have been found to be unsuitable, since these warm water, soft meated species do not produce the high grade of surimi as does cold water, firm meated species (pollock, etc.).

THE SHIPBUILDING INDUSTRY AT BAYOU LA BATRE

General. Based upon the 1987-88 Alabama Directory of Mining and Manufactu and a 1986-1987 field survey by MDO personnel, 700 to 1,000 employees are employed at Bayou La Batre in the shipbuilding industry. These employment figures are shown in this manner in order to reflect the fluctuations of employment in this industry (low to high). Specifically, between the construction of ships, some of the craftsmen may also crew (or captain) a shrimp trawler for himself or the shipbuilder for whom he works as a craftsman. In terms of total employment, shipbuilding is second only to seafood processing in the area.

Company names and type of hull construction and/or repair at each shipyard are listed below in order of their location along the channel from the mouth of the channel landward:

Horton Boats, Inc.	Steel
La Force Shipyard	Steel
Master Marine, Inc.	Steel
Frank Johnson & Sons-Shipbuilding	Steel
Ocean Marine, Inc.	Steel
International Ship-builders, Inc.	Steel
Gazzier Shipbuilding, Inc.	Steel
J & S Fabricators	Steel
Offshore Trawlers, Inc.	Steel
Deep Sea Boat Builders, Inc.	Steel
Herbert Boat Repair, Inc	Wood/Steel
Zirlott Boat Yard	Steel
Randall's Boat Repair	Steel
Rodriquez Boat Builders, Inc. Repair Yard	Steel
Steiner Shipbuilding, Inc	Steel
Landry Boat Works, Inc	Wood
Angus Marine, Inc.	Aluminum

These 17 shipyards constructed approximately 1100 vessels for domestic consumption from 1975-1986 and approximately 250 vessels during the same period for foreign consumption. Most of the vessels constructed for foreign consumption were built during the last four years of this period.

Fourteen of the seventeen shipbuilders are direct descendants of native fishermen, shrimpers or shipbuilders of Bayou La Batre. Specifically, they are, in many cases, third/fourth generation natives who have learned the shipbuilding industry from their fathers/grandfathers. In almost all cases they continue to own and operate shrimping vessels (even fleets of vessels) that the level of knowledge required to design vessels based upon the latest fishing/shrimping technology is continually current. Several of these shipbuilders are presently serving on national fishing technology advisory groups/boards in order to insure that the U.S. fishing/shrimping industry remains highly competitive with foreign countries.

Twelve (12) companies are located along the Bayou La Batre federal channel; two (2) companies are located on Snake Bayou, a tributary to the federal channel; and three (3) shipyards are located on the Bayou, but above the existing Federal project. The analysis of a federal project for Snake Bayou and extending the existing channel above the Highway 188 Bridge shall be discussed after the analysis of potential deepening and/or widening of the existing federal channel.

INEFFICIENCIES IN EXISTING SHIPBUILDING OPERATIONS

Existing Operations. The existing channel dimensions are 12' x 100' up to the turning basin (2.6 acres) and then a channel 12' x 75' up to the Highway 188 bridge. On an annual basis, the seventeen shipbuilders construct an average of 150 vessels and repair an average of 750 vessels based upon field data gathered in late 1986, 1987 and early 1988. Representative annual data is 1986 operations for most shipbuilders at Bayou La Batre; however, some builder's data were averaged over the previous 5-year period, or 1988 confirmed contracts were used as a basis of projecting operations.

The Bayou La Batre shipbuilding industry underkeel clearances of the newly constructed, repaired, or converted vessels during launch and sea trials are 2 feet--1 foot for squat, roll, pitch, and trim and 1 foot for maneuverability and protection of the water intake systems at or near the keel. These shipbuilders are waiting for high tide to launch, seatrial and deliver their vessels. But to maximize profits, the shipbuilders are taking risks to minimize delay time. This behavior to avoid delays waiting for high tide can be two-edged--damages to the vessel and increased construction and/or delivery costs (there is almost always a penalty clause for late delivery in the contract). If the decision to launch or seatrial the vessel without enough depth is made and the vessel is damaged, the original delay is then compounded into production/scheduling delays for the remainder of the vessels in production at that time. This produces a much greater cumulative cost inefficiency than that incurred for just the vessel which was damaged. The risk of reverberating scheduling problems generally compels the shipbuilder to launch, seatrial and deliver the vessel on the highest tide available without undue delay time. Many of the shipbuilders launch their vessels at night with the crews on overtime to avoid damages, even though the vessel has its shallowest draft at launch. More equipment and systems are added for each seatrial, and the draft of the vessel increases until it is fully loaded upon delivery. During each of these steps, the delays waiting for high tide for several consecutive days, particularly during the winter months in which northerly winds suppress already lower than normal tides, compound the risks of damages and ultimately compound production delays. Reference is made to the tidal data previously presented. It is important to stress that costs shown herein for delays and damages have not been double counted. These are additional vessels to those used in the commercial fishing analyses. Several shipbuilders enumerated their damages (which were rather high), but were reluctant to quantify an amount for delays. Their standard response was that delays were a cost of doing business on the 12-foot channel.

Three (3) shipbuilders were splitting the construction of vessels betwee their yard at Bayou La Batre and another rented yard with limited production space and a deeper channel at Pascagoula or Mobile. Extra crew travel and lodging, logistics of moving heavy equipment to/from the rented yard, and reworking /reoutfitting the already outfitted hull which was launched at Bayc La Batre, etc., reduce profit margins for these shipbuilders. But this does not preclude them from being the lowest bidder on contracts for vessels much larger than the largest stern trawlers (freezer processors) built at the Bayou. Their skeleton hulls consistently draft 12 or more feet upon launch; thus, experiencing extensive delays waiting for high tides , as well as extensive damage to rudders, propellers, hulls, and engine systems. It shoul be noted that these large vessels draft 15 to 16 feet upon completion when fully loaded. Also the shipbuilder's bid price includes extra costs for renting another yard with a deeper channel for annual maintenance of these vessels. Even with these extra costs, the Bayou La Batre shipbuilder is highly competitive with other yards (to include foreign builders such as the Japanese).

The available skilled labor, technological innovation through shipbuilding and fishing, and land investment infrastructure at Bayou La Batr prevents the shipbuilders from moving their yards to other places with deeper channels. All of these factors create the highly competitive shipbuilding, conversion and repair industry on this channel.

In summary, inadequate channel depths (particularly during winter months are reported to be the primary cause of delays and damages to the shipbuildir industry along the Bayou. Data supplied by the shipbuilding industry, by shipyard, is confidential in nature and is provided under separate cover for technical reviewers only. The following table is a summary of existing costs incurred by the industry from lack of adequate channel depths.

TABLE 16
Summary of Costs Incurred by the Shipbuilding Industry
located on the Federal channel at Bayou La Batre
October, 1986 Prices
($1,000)

	12 - FOOT CHANNEL			
	DAMAGES	DELAYS	SPLIT OPERATIONS	TOTAL
Reach 1 (3 Shipyards)	0	24.0	0	24.0
Reach 2 (2 shipyards)	0	13.8	0	13.8
Reach 3 (4 shipyards)	210.0	110.2	978.7	1,298.8
Reach 4 a/ (4 shipyards)	100.0	48.0	0	148.0
Reach 5 (3 shipyards	2.7	2.5	0	5.2
Reach 6 b/ (3 shipyards)	--	--	--	--
TOTALS	312.7	198.5	978.7	1,489.8

NOTE: These data include 2 shipyards which were not operational in 1986 and 3 shipyards which started operations in 1986. Four (4) of these 5 shipyards had no additional costs in 1986.

a/ The costs for 2 of these shipyards are related to lack of channel depths in Snake Bayou, not on the Federal channel, and are not included in these figures.

b/ The costs for these 3 shipyards are related to lack of channel depths on the main channel above the Hwy 188 bridge, not on the Federal channel.

ADDITIONAL COSTS AT SNAKE BAYOU AND ABOVE THE HIGHWAY 188 BRIDGE

Existing Costs to Shipbuilders on Snake Bayou. Snake Bayou joins the main channel on the western side of the turning basin. There are two (2) seafoc processing plants and three (3) shipbuilders which use this side channel. fleet of vessels which use these seafood processors are bay shrimpers which draw 3' to 7' of water. A shipbuilder (repair yard) is locatea at the most northwestern end with 7 to 8 feet of water and has an annual operational lc of $119,250 from vessel damages and delays.

A shipbuilder is located at the mouth of Snake Bayou on the northern s and experience an additional annual operational cost of $113,200 resulting from damages and delays. This area usually has 12 feet of water, which is maintained by this shipbuilder. Another shipbuilder has haulout ways on the south side of Snake Bayou at the mouth and incurred delays in the amount of $77,895 annually.

Existing Costs to Shipbuilders on Main Channel Above Bridge.

Three shipbuilders operate above the Highway 188 Bridge with a 12-foot channel which is maintained by the city and incur additional operational cc annually amounting to $110,200, $252,900 29/ and $125,200, or $488,300 in total. A seafood processing plant with its fleet of vessels and numerous other private trawlers utilize this portion of the main channel; however, n of these latter vessels need greater than a 12-foot channel above the bridg

Summary of Existing Cost Inefficiencies at Snake Bayou and Above Highway 18

Table 17 summarizes the additional costs to these six (6) shipbuilders based upon their locations (Snake Bayou or above the bridge).

TABLE 17
Summary of Existing Operational Costs to
Shipbuilders on Snake Bayou and Above the Highway 188 Bridge
($1,000)

	Existing Approximate Channel Depth	Existing Costs			
		Damages	Delays	Split Operations	Total
Snake Bayou					
1 Shipbuilder a/	12 feet	13.0	100.0	0	113.0
1 Shipbuilder b/	12 feet	0	77.9		77.9
1 Repair Yard	6-8 feet	19.3	100.0	0	119.3
Total		32.3	277.9	0	310.2
Above Hwy 188 Bridge					
1 Shipbuilder	12 feet	19.6	233.3	0	252.9
1 Shipbuilder	12 feet	105.1	20.1	0	125.2
1 Shipbuilder	12 feet	0	110.2	0	110.2
Total		124.7	363.6	0	488.3

a/ This shipbuilder's facility is approximately 100 feet from the present turning basin.

b/ This shipbuilder's haulout ways is approximately 50 feet from the present turning basin.

SUMMARY OF EXISTING CONDITION COST INEFFICIENCIES TO ALL INDUSTRIES

Table 18 displays the economic costs from inefficient operations to e industry in the order of their presentation in the preceding paragraphs.

TABLE 18
Summary of Existing Costs
For all Industries on the Federal Channel at Bayou La Batre, AL
October, 1986 Prices
($1,000)

	Existing Costs (12')
Commercial Fishing Fleet	838.0
Butterfish Industry	not available
Simulated Seafood Industry	0
Shipbuilding Industry a/	1,489.8
Other Shipbuilding b/	798.5
Total	3,126.3

a/ These data exclude costs for 2 shipbuilders on Snake Bayou and 3 shipbuilders above the Hwy 188 Bridge.

b/ These data include shipbuilders on Snake Bayou and above Highway 188 Bridge ($310.2 + $488.3 = $798.5. See Table 17).

FUTURE WITHOUT-PROJECT CONDITION

General. This portion of this appendix shall portray how each industry in the Bayou will respond to growth opportunities in the future in the absence of a federal project. This is called future "without-project condition". The period of analysis is 50 years from 1991, which would also be the economic life of a deepened channel. The purpose of this analysis is to capture changes in income streams to the commercial fishing fleet, butterfish industry, simulated seafood industry, and the shipbuilding industry which can be expected in the future without any modification to the existing Federal project for Bayou La Batre.

Since the Bayou La Batre area is considerably developed by fishing interests, seafood processors and shipbuilders, the behavioral choices pertaining to activities which may be taken in the absence of a deeper channel are important in defining a sound Without-Project Condition. The without-project economic setting is portrayed through defining the future use of the channel by vessel operators and shipbuilders. The behavioral responses to inadequate channel depths are depicted as resulting in operational inefficiencies, damages and delays. Vessel owners and operators and shipbuilders are willing to accept a certain level of risk in using the existing 12-foot channel for vessels requiring greater safe operating depths. In the absence of a deeper channel, choices have been made by shipbuilders to split their operation (particularly vessel construction) to capitalize on the economic advantages of the existing labor/technology infrastructure, but at an increased inefficiency. Commercial fishing interest have chosen to fully load large vessels and operate using available high tides, but again at some costs resulting from damages and delays.

The Future Without-Project Condition operational patterns and projections of growth for each of the industries previously discussed under the Existing Conditions are presented in the following paragraphs.

Commercial Fishing Fleet. There is ample evidence that growth is expected in the future in both the demand for and supply of seafood products from Bayou La Batre.

Growth in Demand. U. S. demand for fish and shellfish is increasing much faster than the ability of the U. S. commercial fleet to supply the need. Reported statistics indicate that per capita consumption of edible fish and shellfish in the U. S. has grown 30 percent since 1960 30/. Of the total U.S. consumption only 41 percent is landed by U. S. commercial fishermen 31/ with 8 percent landed by noncommercial U.S. fishermen, and the remaining 51 percent imported from foreign countries. Although U. S. consumption of seafood is increasing, numerous European and Far East countries have 300 to 500 percent greater per capita consumption of fish and shellfish than the U. S. 32/ This increased U. S. demand has been brought about for two (2) reasons:

a. Increasing dietary awareness, and education in the U. S. on the value of low fat/high protein levels of fish and fish related products in a diet; and

b. Increasing levels of fishing technology (harvesting and processing) in the U. S. 33/

Growth in Markets. There are numerous indicators that Bayou La Batre is a dynamic and growing seafood industry and has increased its markets for seafood products in both the U.S. and foreign countries.

First, their seafood processing capability is the largest concentration on the entire Gulf Coast 34/ and continues to grow (reference the 24.0 million-pound capacity surimi plant which was completed in 1987). The 57 processing plants/houses at the Bayou are annually operating at approximately 55 percent capacity based upon data from the Alabama Sea Grant Advisory Service 35/, which means that more than 50 percent of the existing capacity i available for increased production after adding the capacity of the new surim plant.

The shrimping industry in the Gu[illegible]xico (GOM) is the largest in the U. S. in terms of landings; average annual landings in the GOM comprised 76 percent of the total U. S. landings of shrimp during the period 1980-1986. 36 The value of the annual GOM shrimp landings approached $1.5 billion dollars i 1986 using the value-added processing rate found at Bayou La Batre (see Table 5A). Any future growth of this industry would, then, be linked to the supply of shrimp in the GOM.

The available supply (maximum probable catch) of shrimp in the (GOM) has been estimated by the GOM Fisheries Management Plan and is 301.7 million pounds annually, exclusive of 44.8 million pounds apportioned for recreational, bait and discarded shrimp. Based upon the trend line in Figure 2, this supply level will be reached in the year 2001, at which time it will level off and remain constant to the end of project life, or the year 2041. This is a 1.91 percent growth rate from 1988 to 2001.

Growth in the Fleet Size. The sizes of vessels comprising the commercia fleet at Bayou La Batre have been increasing faster than the remainder of the Gulf of Mexico fleet. The Bayou La Batre fleet increased from 56 to 73 net tons per vessel during the period 1970-1980, while the GOM fleet increase fro 55 to 60 net tons per vessel over the same period processors. 37/ Field dat collected by MDO researchers revealed that 5 to 7 large vessels have been added to the Bayou fleet during the summer of 1987 which were in excess of 1C net tons (90 to 100 feet in length; and 12 to 14 feet loaded drafts).

In terms of the number of vessels in the fleet, the Bayou La Batre fleet grew from 369 vessels in 1970 to 534 vessels in 1980, 38/ and subsequently fluctuated to 504 vessels in 1986 based upon our MDO field survey (similair data is not available for the GOM fleet). In summary, the Bayou fleet is relatively stable in number; however, the vessels themselves are rapidly increasing in size. The necessity to travel such long distances (to Louisiana, Texas and southwestern coast of Florida) and preserve their catch for longer periods of time would account for increasingly larger vessels appearing in the Bayou fleet.

Growth in Fleet Operational Costs. Based upon the growth projections discussed in the preceding paragraphs for the fleet and catch, the Future Without Project Condition operational costs are likewise projected to increa 1.91 percent annually to the year 2001 and thereafter remain constant to the year 2041. This growth in operational cost is based upon the premise that th

average size of vessels within the existing Bayou La Batre fleet mix will increase (distribution tending to the longer sizes), and therefore will have longer delays and greater damages as they operate on the existing 12-foot channel. Table 19 presents these losses for the commercial shrimping fleet for Future Without-Project Condition by category and gives their average annual equivalent costs. Each of the other industries' operational costs are discussed in subsequent paragraphs following Table 19.

Future growth in operational inefficiencies/costs of the commercial fishing fleet were discounted to present worth and then amortized over the project life (1991 to 2041) at the FY 1988 interest rate of 8-5/8 percent using a computer program which uses a straight-line interpolation between data points. For the commercial fleet, a 1.91 percent annual growth rate to 2001 with no growth projected thereafter was used based on the trend of growth in the maximum sustainable shrimp catch in the Gulf of Mexico and resultant increases in vessel sizes. This same discounting and amortization procedure was used for the other industries and shall be described in subsequent paragraphs.

TABLE 19
Average Annual Equivalent Operational Costs
for Commercial Fleet at Bayou La Batre
WITHOUT-PROJECT CONDITION
October, 1986 Prices ($1,000)

Category	Existing Costs a/	1991	2001	2041	AAE b/ Costs (1991-2041)
	(1986)	(1.11955)	(1.35141)	(1.35141)	
Vessel Delays	119.2	133.4	161.1	161.1	151.3
Opportunity Costs to Labor	175.4	196.4	237.0	237.0	222.7
Vessel Damages	420.3	470.5	568.0	568.0	533.6
Diver Expenses	46.2	51.7	62.4	62.4	58.6
Additional Travel Time via Petit Bois Pass	76.9	86.2	103.9	103.9	97.6
Totals	838.0	938.2	1,132.5	1,132.5	1,063.9

a/ See Table 14.

b/ AAE - "Average Annual Equivalent" (50 years at 8-5/8 percent interest).

Butterfish Industry. It is expected that the butterfish industry will become a growth industry on the Gulf Coast February through November each year. This is based upon the results of research and teaching efforts of the NMFS Research Labs at Pascagoula, Mississippi. In May, 1988, NMFS representatives at Pascagoula report that there were 10 large converted shrimp trawlers and 6 New England freezer processors fishing for butterfish in 1988. The catch rates for these freezer processors have doubled or tripled and the number of trips are six-fold over the 1986 conditions previously described. Deep Sea Foods, Inc., of Bayou La Batre converted their largest trawler to a butterfish boat for the 1988 season. The kind of butterfish boats expected to operate out of the Bayou will be converted shrimp trawlers until 1991. Thereafter, the freezer processors of the sizes used on the East Coast and now operating out of Pascagoula will become dominant in butterfishing from the Bayou. This prediction is based on the economies of scale of the freezer processor compared to a converted trawler. Under optimal conditions, a modern freezer processor can catch, sort, package and freeze 300,000 pounds of butterfish at sea in sorted "swim" packs in 5 days at an ex-vessel value $180,000 per trip or $10,800,000 annually (60 trips, February-November; see Confidential data, August 22, 1988 price quotations). The converted trawler can catch 50,000 pounds per trip worth $30,000 in 2.5 days at the same ex-vessel value or $3,600,000 annually at slightly less operating costs per trip than the freezer processor (120 trips compared to 60 trips for the freezer processor). Even if more value can be added to the butterfish with extra dockside processing and a higher price per pound can be obtained for the entire catch of the converted trawler, the economies of scale of the larger modern freezer processor will dictate their use through Pascagoula, Mississippi under future without project condition at additional operating cost as discussed below. Therefore, the number of freezer processors and their expected catches at Bayou La Batre in the future are described below.

On the East Coast approximately ten (10) freezer-processor stern trawlers dually fish butterfish and other species. The estimated East Coast annual biomass of butterfish is 16,000 metric tons with an 11,000 metric ton annual yield; therefore, it is expected that 20 freezer processors will fish the 34,000 (minimum) metric ton yield in the Gulf of Mexico (estimated range of butterfish biomass is 34,000 to 150,000 metric tons). If all the major shrimp ports along the Gulf of Mexico were to share this fleet proportional to their shrimp processing market share, three (3) freezer processors would be homebased at the Bayou. This projection is consistent with the Bayou's market share of the Gulf of Mexico shrimping industry (42.5 million pounds of shrimp processed out of 301.7 million pounds available, or .14 x 20 vessels = 2.8 vessels). It is estimated that their future catches will closely match their 1988 catch rates, vessel trips and trip lengths but limited to the 1986 season length of February to May. Accordingly, three processors would catch 9,606,000 pounds of butterfish during an average season (90 days divided by 4.50 days per trip = 20 trips x 160,100 lbs/trip x 3 vessels). The butterfish will have been processed at sea on the freezer processor vessel. Since the vessel cannot come into the Bayou without deeper channel depths and better channel availability, the processed catch would be unloaded at Pascagoula, Mississippi resulting in an extra $.0.13 per pound cost to vessel owner as described in Table 20.

TABLE 20
Comparison of Additional Costs Per Pound to Deliver/Hold
Butterfish Catch at Pascagoula, Mississippi versus Bayou La Batre
(Vessel: Freezer Processor)

Extra Costs	Pascagoula	Bayou La Batre
Wharfage a/ & stevedoring b/	$ .05	$ .00
Cold storage c/	.05	.00
Containerized trucking to Mobile d/	.05	.02
Crew/vessel cost to BLB e/	.00	.01
Extra fuel/provisions costs in Mississippi	.01	.00
Total	$ .16	$ .03

a/ Wharfage = vessel dockage fee
b/ Only bonded personnel can put the product in the facility.
c/ Only bonded personnel can stage the product for shipment.
d/ Closest container port
e/ Foregone crew/captain earnings and extra vessel fuel consumed for the vessel to travel from the juncture of the GIWW-E/Pascagoula channel to BLB.

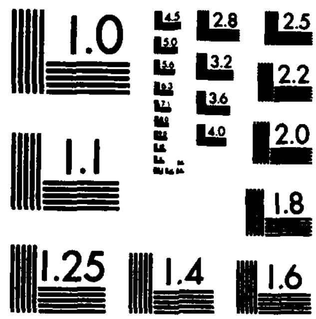
The extra cost per pound to land the butterfish catch at Pascagoula compared to landing at their own plants at the Bayou would be $.13, which amounts to $1,248,800 annually. These freezer processors draw 15 feet of water loaded and must have 2 feet of underkeel clearance as previously discussed in this text. This results in a required navigation depth of 17 feet, which is never available at Bayou La Batre, even under extreme high tidal conditions.

As previously discussed, bringing the butterfish vessels into Bayou La Batre would be more efficient than porting at Pascagoula. Freezer capacity and existing labor resources now available in the Bayou could be more fully utilized, and overall handling requirements reduced. Butterfish will be sized, packed into small boxes, and frozen on the freezer processor vessels while at sea; but, there are additional logistical requirements involved in the marketing of the product to foreign brokers, that make operation from Bayou La Batre more efficient. The boxed and frozen butterfish are accumulated in the freezer warehouses and sorted by size (grade) after each vessel trip. The largest sizes are more desirable in Japanese markets and are sold first early in the season; as demand adjusts later in the season smaller sized fish are sold to the foreign buyer. These wholesale lots are by size and consist of container loads for shipment to Japan.

Simulated Seafood Industry. MDO researchers found no reason to forecast any economic growth for surimi at this time under the Without-Project Condition.

AD-A201 866 FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT FOR NAVIGATION IMPR..(U) CORPS OF ENGINEERS SOUTH ATLANTIC MOBILE AL COASTAL SECTION.. J K GRAHAM ET AL. 2/6

UNCLASSIFIED 12 SEP 88 COESAM/PDFC-88/05 F/G 13/2 NL


1.0
4.5
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1.25
1.4
1.6

Shipbuilding Industry. Based upon increased world and U.S. demand for seafood products mentioned in previous paragraphs, fishing technology is expected to improve to meet this demand. These changes in fishing technology are already emerging with freezer-processors (stern trawlers), which allow longer fishing trips with increased capability of the vessel to hold larger refrigerated loads and to process products aboard ship. In other nations where fishing technology contributes a larger share of their gross national product (GNP), these freezer-processors are not only larger, but serve as a "factory" for a fleet of fishing vessels. 39/ It is anticipated that the fishing industry in the Gulf of Mexico will follow trends which exist on the East Coast of the U.S., which means that stern trawlers will not become "factory" vessels serving many auxiliary vessels, but will be processors of their own catch. 40/ However, the shipbuilders at Bayou La Batre are not limited to the level of fishing technology on the Gulf of Mexico. They are breaking into, and in several cases, controlling the shipbuilding trends in foreign markets where fishing and fishing technology are growth industries. 41/ (In support of this conclusion, four (4) Bayou La Batre shipbuilders who chose to list their deliveries of vessels in 1986 with The Fish Boat, the following numbers of vessels were delivered to foreign countries: 12 to El Salvador; 11 to Honduras; 11 to Nigeria and 2 to West Africa; or, 80% of their production was for foreign customers.) The eleven (11) vessels delivered to Nigeria by Ocean Marine, Inc. under Existing Condition were semi-freezer processors, or trawlers with larger freezer space and processing capabilities.

To summarize the demand for worldwide shipbuilding, there is an increased demand for more and larger fishing vessels. This increased demand for new construction and conversions of various types of vessels includes vessels for the U.S. military and other governmental agencies (U.S. Coast Guard, Navy, NOAA, etc.). Shipbuilders at the Bayou will continue to split their construction operations for vessels with drafts greater than those available currently in the Bayou. The result of future split operations is increasingly higher production costs, and some future loss of competitiveness in the world market for larger vessel bidding.

Demand is not the only reason Bayou La Batre shipbuilders will experience growth in the future. The other major reason these shipbuilders can expect continued growth is that they have three (3) competitive advantages over the other medium- and larger-sized shipyards in the U.S.:

1. Multi-skilled, non-union [illegible] across skill lines and construct vessels 20 percent faster and 30 percent cheaper since they report to only one (1) layer of management--the owner; and

2. Continued hands-on experience in developing fishing technology in the U.S. (ownership of fleets of fishing vessels and service on national fishing advisory boards by shipbuilding management).

3. A proven record of producing a quality product at a competitive price. Thirty-five (35) percent of the 150 newly constructed vessels in 1986 were for foreign consumption and were from 90 percent repeat or referred customers as evidenced by shipbuilding news articles.42/ Based upon field data, most of the remainder of the vessels built annually (domestic consumption) are also from repeat or referred customers.

In summary, Bayou La Batre shipbuilders forecast that they will double the number of vessels built over the 50 year without-project period of analysis. Accordingly, they will incur increasing amounts of damage and delay during launches, sea trials and deliveries since more vessels will be built and these vessels will be progressively larger in size. Their competitive posture will entice them to bid and win contracts for vessels which will require further split operations (construct the hull with a 12-foot channel and then outfit, test and pull required maintenance on the loaded vessel at another location) at larger costs to these shipbuilders. It is felt that over the period of analysis, the shipbuilding industry at Bayou La Batre will have incurred cost inefficiencies equal to double their existing costs by the year 2041. This represents a 1.4 percent growth in cost inefficiencies annually over 50 years.

SUMMARY OF FUTURE WITHOUT-PROJECT CONDITION COST INEFFICIENCIES FOR ALL INDUSTRIES.

No growth was projected for the surimi or butterfish industries under the Without-Project Condition. However, growth was projected for two industries, commercial fishing for shrimp and shipbuilding. A 1.91% annual growth in the amount of shrimp landed was projected to the year 2001, with no growth beyond year 2001 up to the year 2041. For the shipbuilding industry a 1.4 % annual growth was projected in operational cost inefficiencies. Table 21 summarizes the Future Without-Project Condition operational cost inefficiencies for continued commercial use of the existing Bayou La Batre Channel.

TABLE 21
Summary of Without-Project Condition Average Annual Equivalent Operational Cost Inefficiencies at Bayou La Batre
(October, 1986 Prices)

	Total Costs (12') ($1,000)
Commercial Fishing Fleet	1,063.9
Butterfish Industry	1,248.8
Simulated Seafood Industry	0
Shipbuilding Industry a/	1,759.6
Other Shipbuilding b/	939.9
Total	5,012.2

a/ These data exclude shipbuilding operations on Snake Bayou and above the Highway 188 Bridge.

b/ These data are for Snake Bayou and the operations above the Highway 188 Bridge. Also shown included are operational cost inefficiencies for an additional shipbuilder who is located just below the Highway 188 Bridge, but was not include in those shipbuilders located along the existing Federal Project Channel.

WITH-PROJECT CONDITIONS

Table 22 summarizes the average annual equivalent operational cost inefficiencies, costs inefficiencies remaining under with-project conditions and the eliminated cost inefficiencies (benefits) by industry for each channel depth considered under various with-project condition scenarios. In summary, a 16-foot channel eliminates almost all the future without-project operational cost inefficiencies to the commercial shrimping fleet; and an 18-foot channel would eliminate all the operational cost inefficiencies to the other two industries at Bayou La Batre. The derivation of benefits for each channel depth by industry is discussed below.

14-foot Channel. Based upon Table 22, [illegible] of the delays, damages and other additional operational costs of the commercial fleet would be eliminated with a 14-foot channel. Since 71 percent of the gulf trawlers in this fleet draft 12 feet when fully loaded and cannot exit or enter this channel when high tides are not available, particularly during winter months when low tides combine with northerly winds, the benefits to a 14-foot channel become evident.

Two (2) feet of underkeel clearance was added to the loaded draft of the shrimp trawlers (as shown in Table 8B) to determine the channel depth which would eliminate the cost inefficiencies. This procedure was also used for the other industry vessels.

The shipbuilding industry at the Bayou would have almost 100 percent of their launch, seatrial and delivery delays and damages removed with a 14-foot channel for most of the trawlers constructed or repaired in the Bayou under the existing condition. Most of the non-trawler vessels (military, etc.) would not benefit from a 14-foot channel.

16-foot Channel. The draft requirements of the commercial shrimping fleet would be almost fully met at 16 feet (99 percent). However, damages and delays of the larger local stern trawlers (semi-processors) used in the commercial fleet would still remain at 16 feet.

There are no benefits to the butterfish industry at this channel depth since these freezer processors which would start operations out of Bayou La Batre in the first year of project life (1991) will have loaded drafts of 15-feet and must have 2-feet underkeel clearance.

In addition to the benefits shown for a 14-foot channel for shipbuilding, some of the smaller split operations and offshore operations could be accomplished in the Bayou with a 16-foot channel and thus, become benefits to a 16-foot channel.

18-Foot Channel. All additional operational costs for the commercial shrimping fleet would be eliminated at this depth. Even if the Bayou's gulf fleet should be replaced with all stern trawlers (semi-processors), an 18-foot channel would accommodate these vessels.

The stern trawlers (freezer-processors) used in the butterfish industry at the Bayou under Future Without-Project Conditions could deliver their catch dockside at the Bayou instead of landing their catch at Pascagoula, MS. All these extra trucking and handling costs identified under the without-project would be eliminated with an 18-foot channel.

All delays and damages related to new construction in the shipbuilding industry would also be eliminated at 18 feet. This includes the major split operations for military vessels which will occur under the Future Without-Project Condition. But, the repair of small tankers and research vessels off Petit Bois Island will continue to occur with this channel depth in the Bayou.

20-foot Channel. The only additional direct benefits to a 20-foot channel over an 18-foot channel accrue from the small tankers and research vessels which are repaired off Petit Bois Island by one of the shipyards in Reach 3. These small tankers and research vessels could be repaired dockside in Bayou La Batre with a 20-foot depth. This would eliminate the additional expenses associated with the repairs now made at Petit Bois Island.

TABLE 22
WITH-PROJECT
Average Annual Equivalent Costs Remaining and Benefits
By Channel Depths at Bayou La Batre
October, 1986 Prices
($1,000)

	Without-Project AAE Costs	WITH-PROJECT AAE Costs Remaining 14'	16'	18'	20'	AAE Benefits 14'	16'	18'	20'
Commercial Fishing Fleet a/	1,063.9	162.3	9.6	0	0	901.6	1,054.3	1,063.9	1,063.9
Butterfish Industry	1,248.8	1,248.8	1,248.8	0	0	0	0	1,248.8	1,248.8
Simulated Seafood Industry	0	0	0	0	0	0	0	0	0
Shipbuilding Industry:									
Main Channel a/	1,759.6	1,215.4	1,185.8	12.8	0	544.2	573.8	1,746.8	1,759.6
Snake Bayou	365.1	0 b/	0	0	0	365.1 b/	365.1	365.1	365.1
Above 188 Bridge	574.8	0	0	0	0	574.8	574.8	574.8	574.8
TOTALS	5,012.2	2,626. 5	2,444.2	12.8	0	2,385.7	2,568.0	4,999.4	5,012.2

a/ These data exclude industries located along Snake Bayou above the Highway 199 Bridge.

b/ $140.4 are benefits to a 12-foot channel in Snake Bayou beginning approximately 400' from mouth and for approximately 900 feet.

Note: "AAE" = Average Annual Equivalent

SENSITIVITY ANALYSIS

The operating costs and related project benefits associated with lack of depth, which have been presented in the above paragraphs, are alternative without-project condition scenarios. Four (4) alternative scenarios are discussed below.

No Growth in All Four Industries. Should each of the four industries discussed herein remain at 1986 levels and only experience existing condition additional operational costs during the Future Without-Project period, benefits to a 14-, 16-, 18- and 20-foot channel would be less than those computed for the most-likely without-project condition scenario. These reduced benefits are shown in Table 23.

Non-Development of Butterfish Industry. Should this industry not be developed during the Future Without-Project period and other industries remain at 1986 levels, the benefits to the 14- and 16-foot channels would be the same as those shown in Table 23. The benefits to the 18- and 20-foot channels would be $3,115,400 and $3,126,200, respectively as shown in Table 23. However, there is ample evidence that the butterfish industry will fully develop since large research and capital outlays for conversion of 10 Gulf of Mexico trawlers have already occurred.

Discontinuance of Split-Operations by Shipbuilders. Should none of the 17 shipbuilders attempt any split operations in order to construct larger vessels under the without-project period of analysis, the benefits to the 14-20-foot channels would be $2,385,700, $2,568,000, $3,825,600 and $3,825,600, respectively (see Table 24). The capital, technology and labor infrastructure of the shipbuilding industry at the Bayou will, however, continue to attract customers who demand quality-constructed larger vessels at the cheapest price available.

Other Considerations. There are three (3) factors which can directly affect the commercial shrimping fleet and concomitantly the shipbuilding industry at Bayou La Batre. These factors are listed and discussed below.

a. The impending required use of a turtle excluder device (TED) by shrimp vessels which could/could not affect the future level of shrimp catch in the Gulf of Mexico;

b. The potential 30 percent marsh loss with a resulting 30 percent decrease in shrimp yield in the Gulf of Mexico as indicated in Louisiana Coastal Area, Louisiana Land Loss and Marsh Creation, Initial Evaluation Study, New Orleans District, USACE, November, 1984; and,

c. The possible passage of state legislation in Louisiana which would tax the trucking of shrimp landed in Louisiana to other states for processing.

Turtle Excluder Device. Based upon information from NMFS, Pascagoula, MS, there are numerous beneficial reasons for the GOM Fisheries Management Council to require GOM shrimp trawlers to use the TED. 43/ There will be 97 percent protection for several species of sea turtles in the GOM which are on the endangered or threatened species list, particularly the Kemp's Ridley sea turtle (*Lepidochelys kempii*), while also preserving the shrimp catch.

TABLE 23
No Growth Scenario - All Industries on Federal Channel
at Bayou La Batre, Alabama
October 1986 Prices ($1000)

	Existing Costs (12')	Costs Remaining				Benefits			
		14'	16'	18'	20'	14'	16'	18'	20'
Commercial Fishing Fleet	838.0	136.6	8.7	0	0	701.4	829.3	838.0	838.0
Butterfish Industry	N/A	0	0	0	0	0	0	0	0
Simulated Seafood Industry	0	0	0	0	0	0	0	0	0
Shipbuilding Industry:									
Main Channel	1,489.8	1,029.0	1,004.0	10.8	0	460.8	485.8	1,479.0	1,489.8
Snake Bayou	310.2	0	0	0	0	310.2	310.2	310.2	310.2
Above Hyw 188	488.2	0	0	0	0	488.2	488.2	488.2	488.2
Totals	3,126.2	1,165.5	1,012.7	10.8	0	1,960.6	2,113.5	3,115.4	3,126.2

a/ Cost inefficiencies to shipbuilders on Snake Bayou and above Highway 188 are not included in this table.

Table 24
Non-Development of Split Operations
October, 1986 Prices ($1,000)
(All Channels)

	Without-Project Costs	Costs Remaining				Benefits			
		14'	16'	18'	20'	14'	16'	18'	20'
Commercial Fishing Fleet	1,063.9	162.3	9.6	0	0	901.6	1,054.3	1,063.9	1,063.9
Butterfish Industry	1,248.0	1,248.0	1,248.0	0	0	0	0	1,248.0	1,248.0
Simulated Seafood Industry	0	0	0	0	0	0	0	0	0
Shipbuilding Industry:									
Main Channel	573.8	29.6	0	0	0	544.2	573.8	573.8	573.8
Snake Bayou	365.1	0	0	0	0	365.1	365.1	365.1	365.1
Above 188 Bridge	574.8	0	0	0	0	574.8	574.8	574.8	574.8
Total	3,825.6	1,439.9	1,257.6	0	0	2,385.7	2,568.0	3,825.6	3,825.6

Further, the finfish bycatch (100 percent kill) in the shrimp nets will be reduced. Historically, the shrimp nets catch 10 to 12 times the weight of the shrimp catch in sports and ground fish much of which are discarded or wasted in the GOM. The TED'S are expected to prevent over 50 percent of this waste.44/

The TED's will be required March 1, 1988 by shrimpers in the area of the GOM from the barrier islands to 15 miles in the open Gulf where the large female turtles are most vulnerable; and will also be required inside the islands (inshore) if the shrimper trawls for more than 90 minutes continuously. The NMFS device is a collapsible, two-pipe device installed in the nets which allows large objects to escape unharmed but retains the shrimp catch. The NMFS at Pascagoula feels that this device (costing $350-$400 to construct and install in the nets) will have a positive effect on the total GOM shrimp catch and costs thereof will be immediately recoverable for the following reasons: 45/

a. Less time will be spent by the shrimper sorting the shrimp catch because less bycatch will be in the nets;

b. the quality of the shrimp catch will increase since the heavy bycatch will not crush/break the shrimp;

c. fuel consumption will decrease because of lesser weight in the nets;

d. the life of the nets will increase since the bycatch will be more than 50 percent reduced during long drags; and

e. the needless finfish kill by shrimpers will be more than 50 percent reduced, which is encouraged by sports and ground fisherman. (Based upon this rationale, 1.8 billion pounds of finfish were wasted shrimpers in 1986, or 304,000 pounds of shrimp x 10 x .60% would have been saved.) These officials believe that the decline in the croaker biomass in the GOM in the last 15-20 years is directly related to the shrimping intensity in the GOM.46/

Marsh Loss. There is a hypothesis that a 30 percent marsh acre reduction west of Mississippi River to the Texas Border would result in a 30 percent decrease in all GOM fisheries yield. MDO researchers believe that the trend in shrimp yields for this exact area along the Louisiana Coast (Mississippi River to Texas border) does not support such a hypothesis. Based upon data for this area from 1980 to 1986, 47/ shrimp landings have increased dramatically (103.1 to 165.7 million pounds). MDO researchers feel that existing data supports a stable biomass of shrimp in the Gulf of Mexico, which is also the position of the GOM Fisheries Management Council.

Pending Legislation. Only 34 percent of the shrimp processed at the Bayou is landed at the Bayou; the remainder is trucked in from mainly Louisiana. The State of Louisiana was contemplating passing legislature in early 1987 which would heavily tax, at the point of sale, the shrimp which are then trucked out of the state. Based upon information furnished by Mr. Ted Flowers, NMFS Representative at Bayou La Batre, this proposed action by Louisiana would not affect the landings nor processing level at the Bayou since the major seafood processors at the Bayou have purchased seafood houses in Louisiana during 1987 which circumvents a "sale" in Louisiana. In other

words, there is no concern that the level of the seafood processing industry at the Bayou will decrease in the future. Should Louisiana become even more aggressive in taxing and/or stopping their landings from being trucked to the Bayou, it is expected that the average size of the Bayou La Batre vessel will increase even more. Such actions would cause the stern trawler ("freezer processor") to emerge at Bayou La Batre more quickly in the shrimping industry.

Summary of Sensitivity Analysis.

In summary the costs stated herein under the Future Without-Project Condition for the commercial shrimping fleet have been accurately portrayed for the following reasons:

a. a stable shrimp biomass exists in the GOM;
b. a 50 percent underutilization of seafood processing capital investment exists;
c. a fleet of larger-sized vessels will exist in the future; and
d. an increased level of shrimping technology will continue which is unsurpassed in the Gulf of Mexico.

The costs associated with the butterfish industry are an extension of the trend of the commercial fishing fleet. Large freezer processors like the ones from the Atlantic will quickly emerge in the Bayou. Split operations in the construction of larger vessels by shipbuilders will occur under future without-project condition.

The simulated seafood industry is in the developmental stage in the US. A new use for "trash fish" caught in most commercial fishermen's nets could awaken this new industry in the U.S. Based upon coordinated research by the U.S. Government (NMFS, FDA, etc.), this product can gain the same acceptance in the U.S. as it has in Asian countries (Japan, particularly). No cost inefficiencies have been shown under Future Without-Project Condition for this industry. Although there is no certain indications at present, MDO researcher's feel that this industry could at some time develop on the Gulf Coast using Gulf of Mexico species as raw material. If this happens, inefficiencies in the Bayou have been understated.

It could be contended that the Bayou La Batre shipbuilding industry is a direct mirror of the existing fleet at the Bayou. However, 35 percent of the 1986 construction level of new vessels was for foreign buyers and use. More than 50 percent of the vessel construction schedules at the Bayou have been for foreign operators in 1987.48/ This ratio is expected to reach 90 percent in the future based upon fastly emerging fishing technologies in the Central and South Americas, India, Indonesia, Africa, etc., all of which are demanding higher and faster construction levels of the Bayou La Batre shipbuilders which build these vessels at costs of about 30 percent less than their closest U.S. competitors. As has been stated, this is due to excellent technology levels, low overhead, non-union, cross-skilled labor forces. Their high-quality, low cost deliveries have built a reputation in numerous countries which precludes U.S. competitors from even bidding on fleets of vessels demanded by these foreign customers. Therefore, the projections of the growth of losses presented under the Future Without-Project Condition for foreign shipbuilding businesses are likely understated. The Bayou La Batre shipbuilders feel that

the only reason construction of larger vessels for foreign customers is not now accomplished by Bayou La Batre shipbuilders is lack of channel depth.

As for future U.S. Government vessel construction at Bayou La Batre, the MDO field researchers found repeated denial on their bids for U.S. Coast Guard and Navy vessels to be solely lack of channel depth on the Bayou La Batre channel. It is likely that these shipbuilders will continue to annually attempt split operations in order to construct vessels for this market.

In summary, the Future Without-Project Condition losses enumerated herein associated with all the industries located along this channel are a most-likely (yet conservative with respect to project justification) representation of future without-project operations. Under differing future conditions, as described above, the d[illegible] of the Bayou could result in much more substantial operating cost savings, as well as local economic growth.

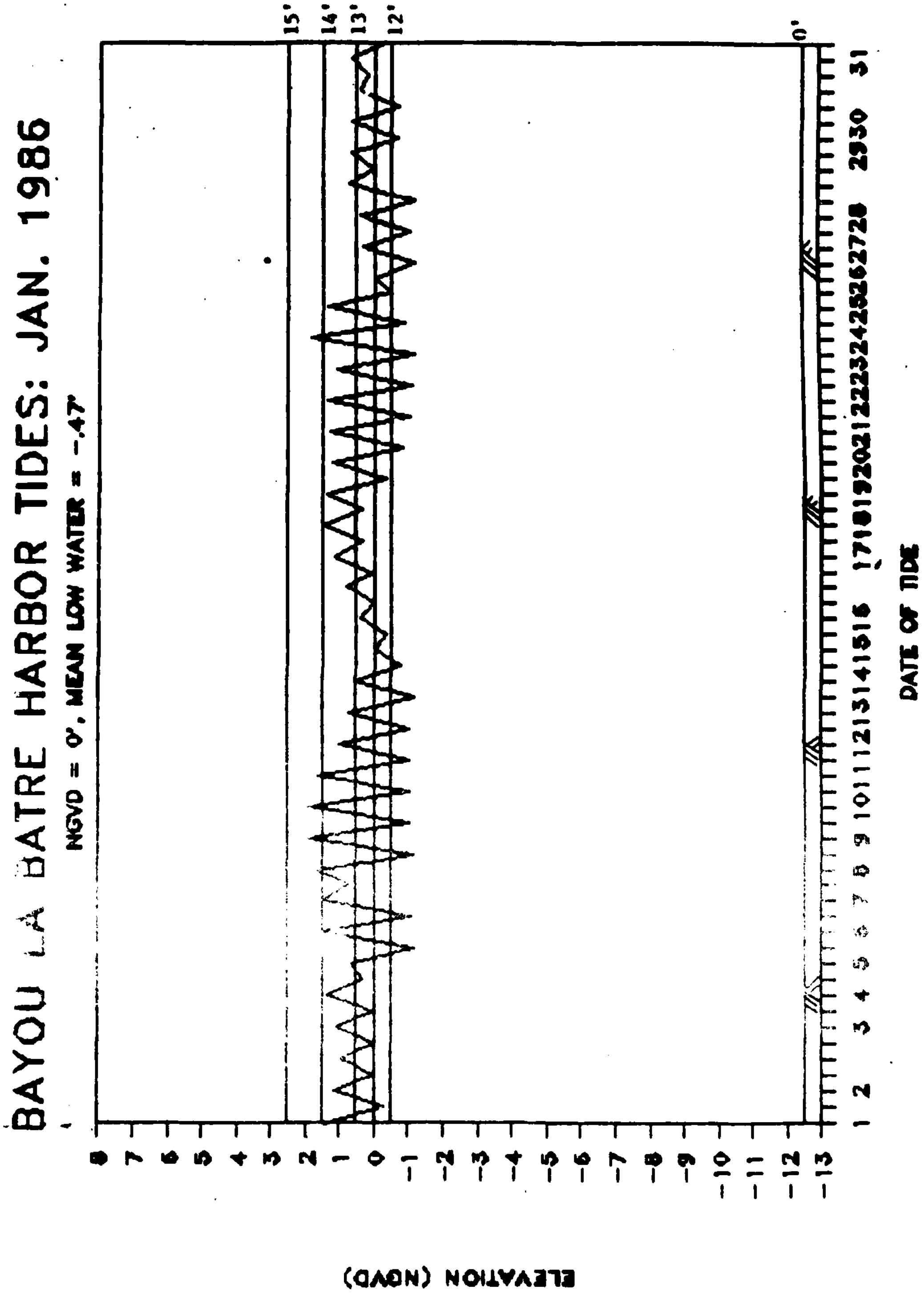

Figure 4
Tide Elevations, Jan. 1986

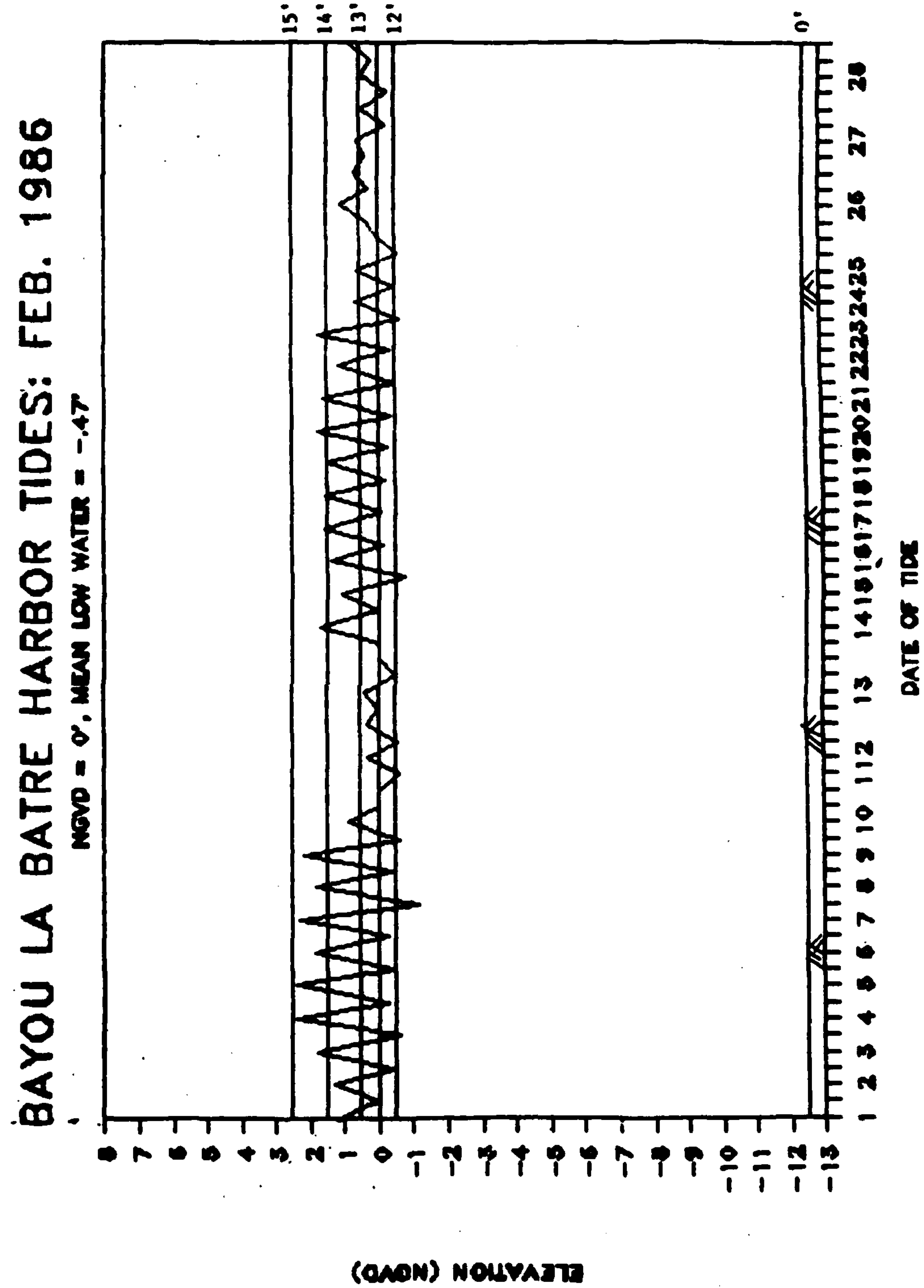

Figure 5
Tide Elevations, Feb. 1986

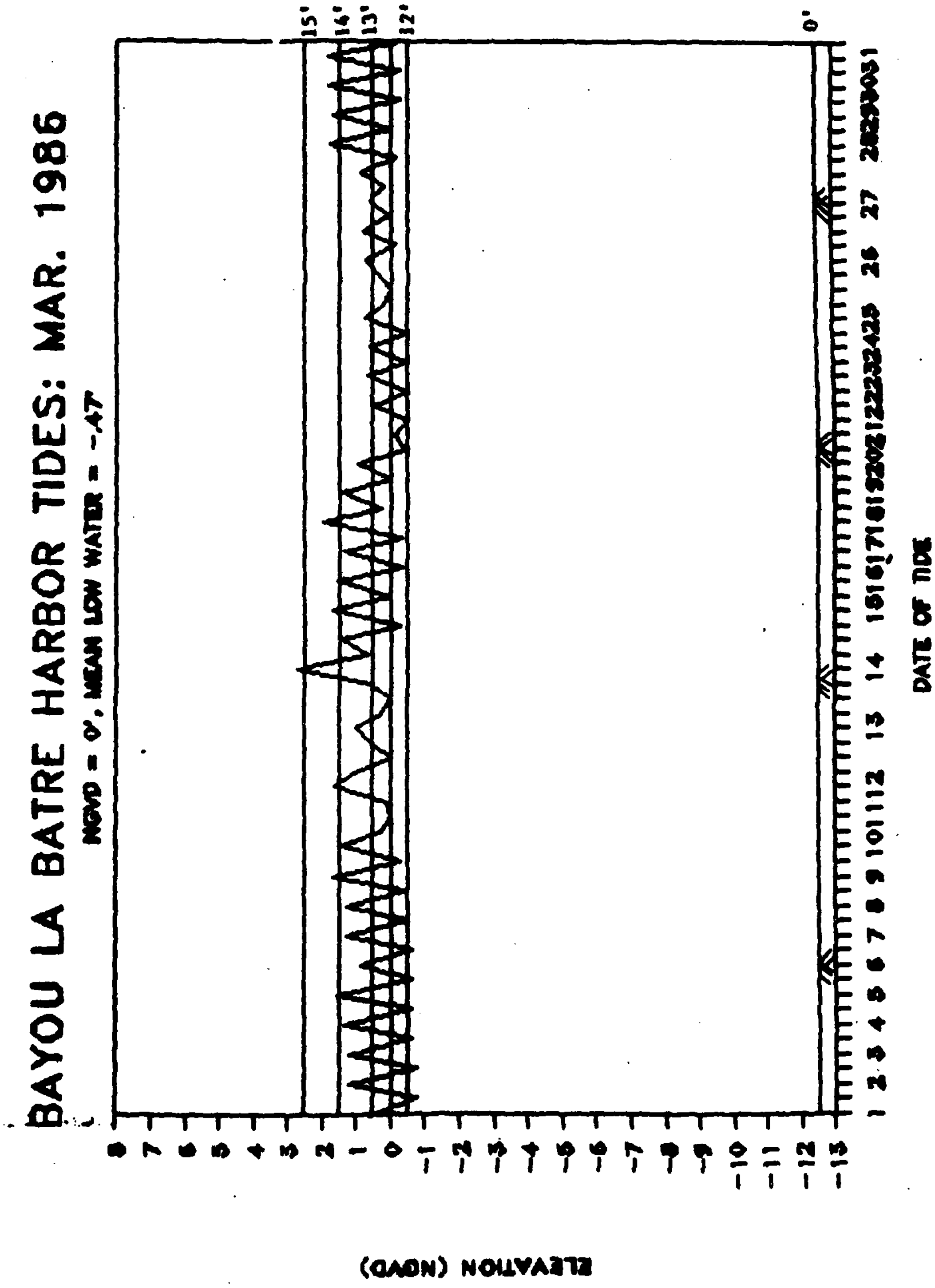

Figure 6
Tide Elevations, Mar. 1986

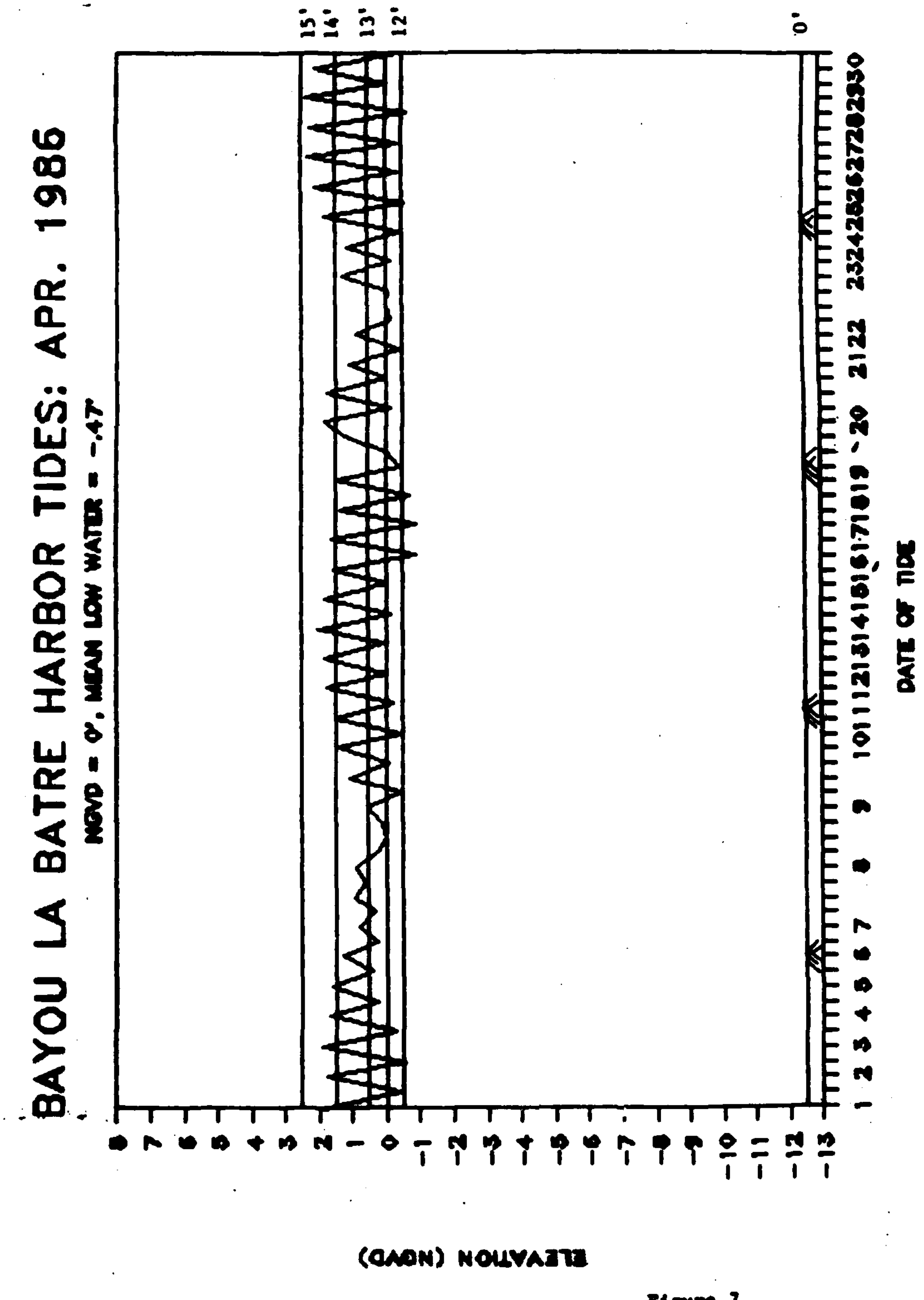

Figure 7
Tide Elevations, Apr. 1986

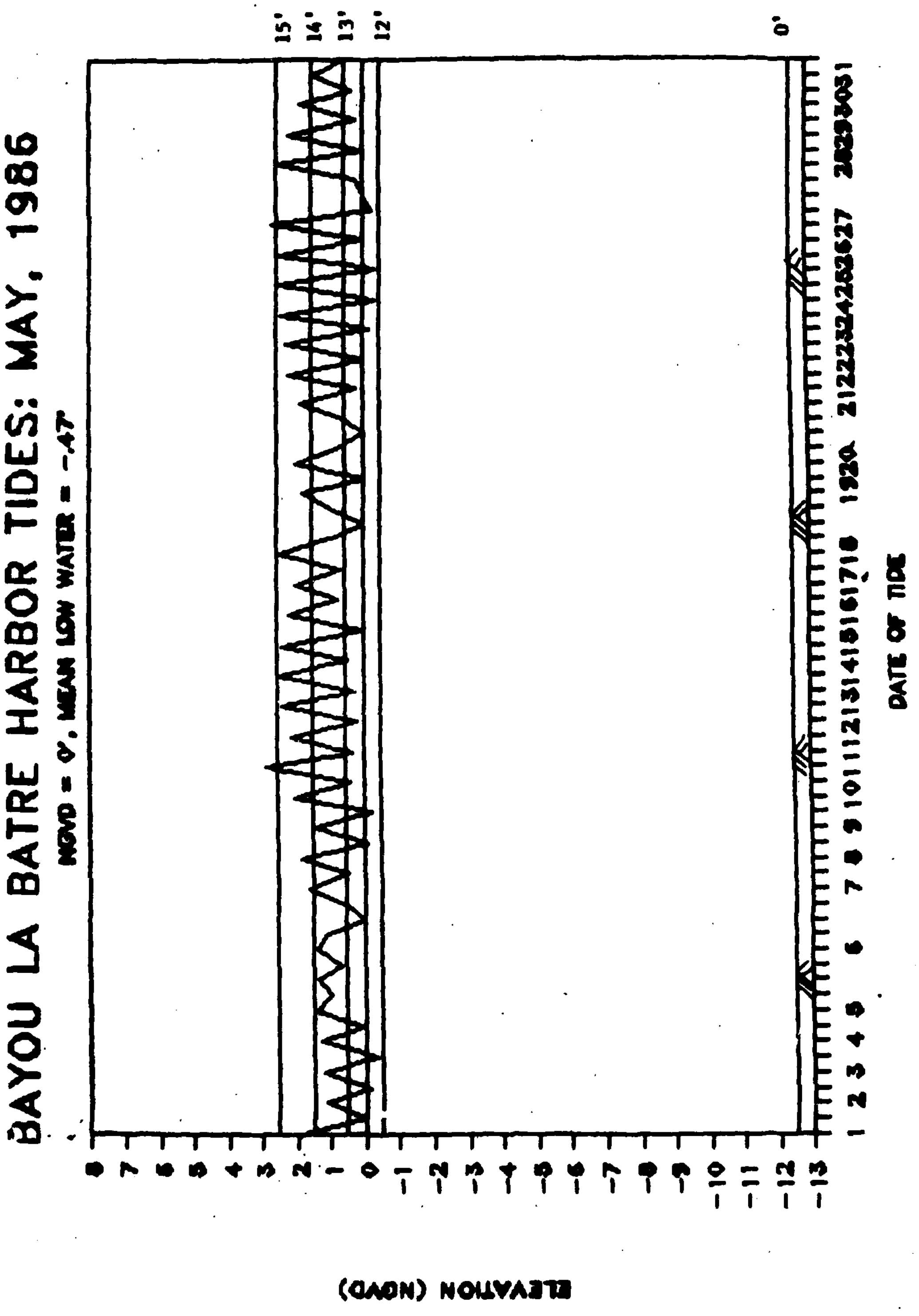

Figure 8
Tide Elevations, May 1986

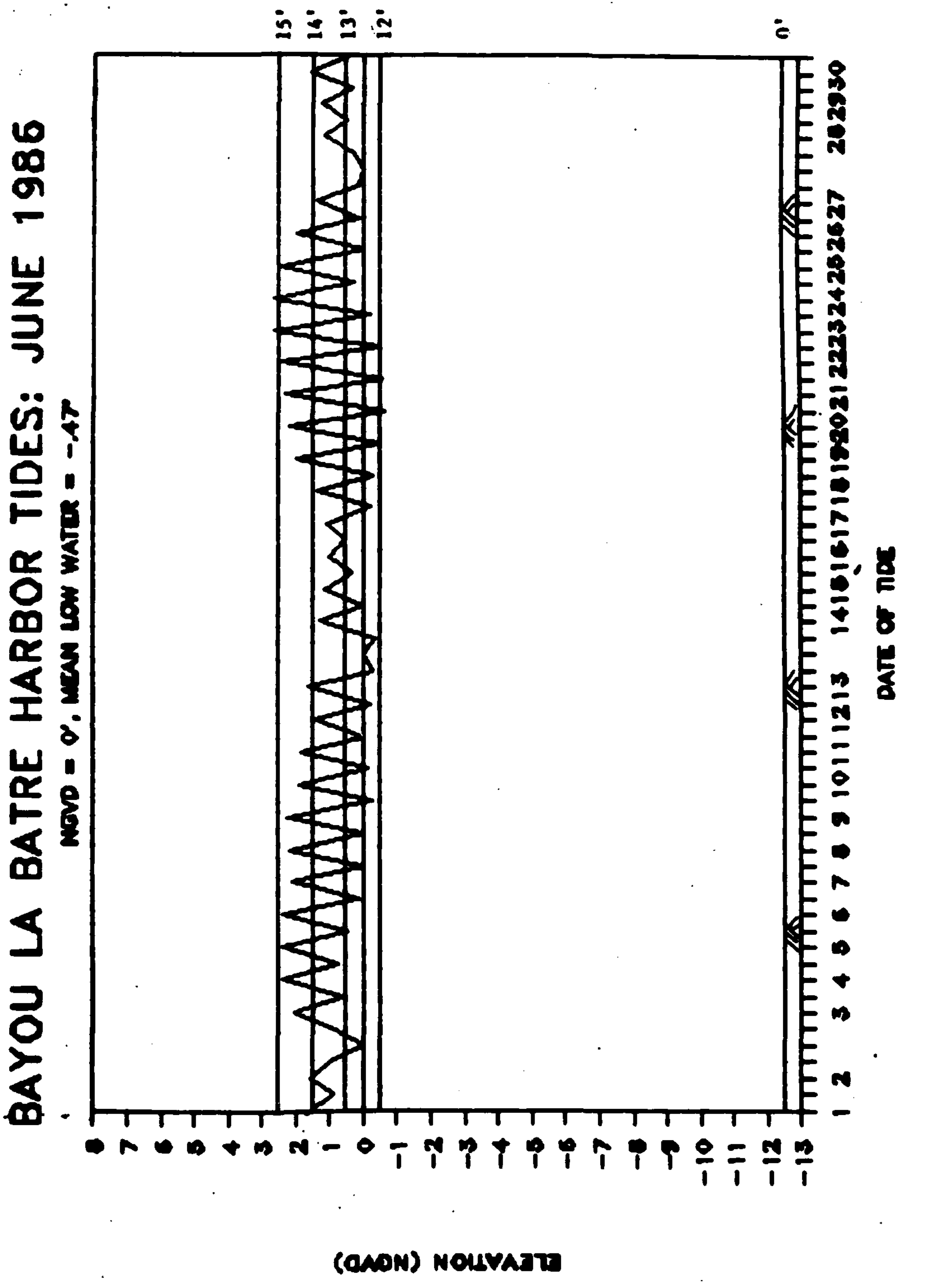

Figure 9
Tide Elevations, June 1986

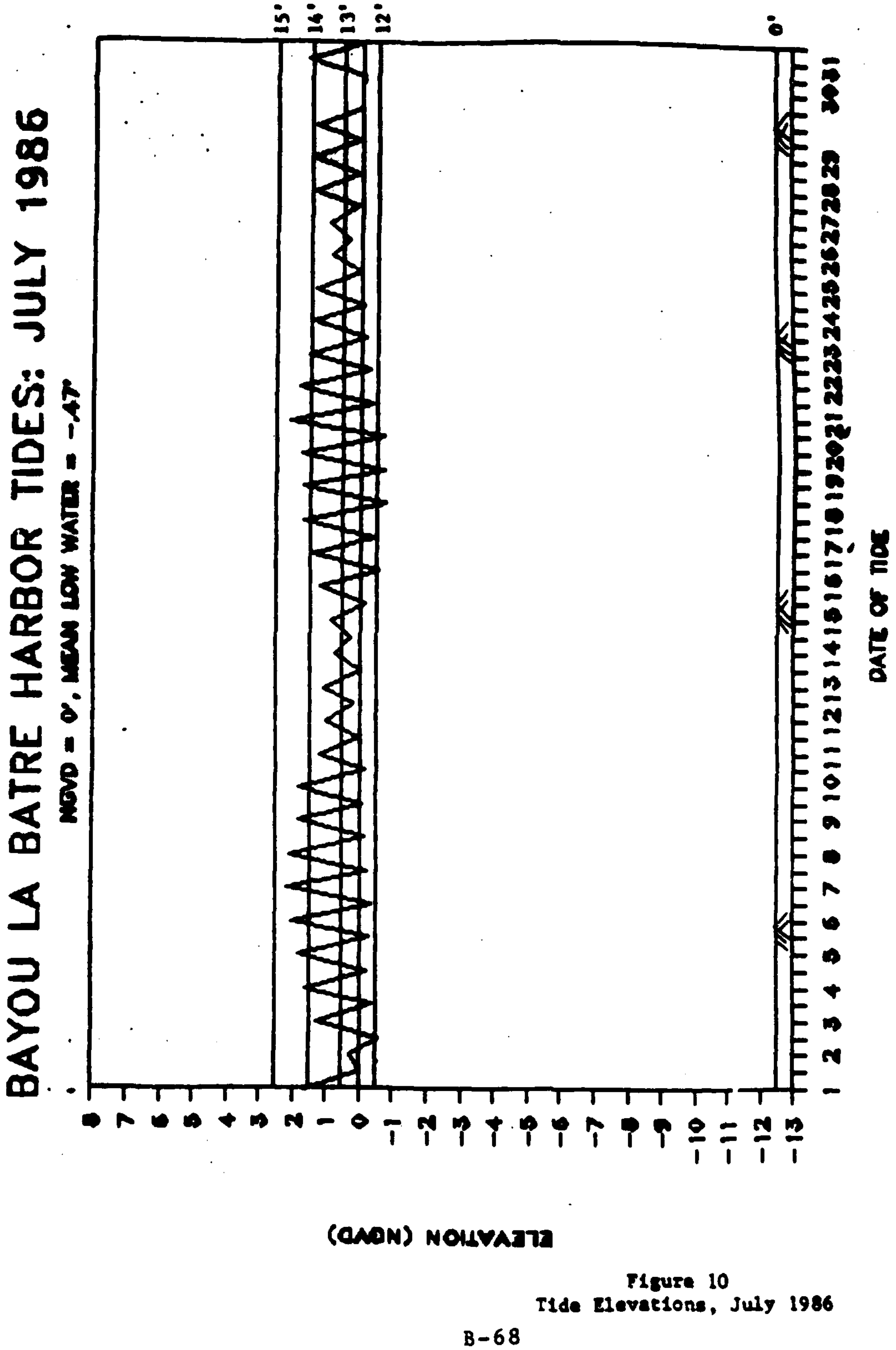

Figure 10
Tide Elevations, July 1986

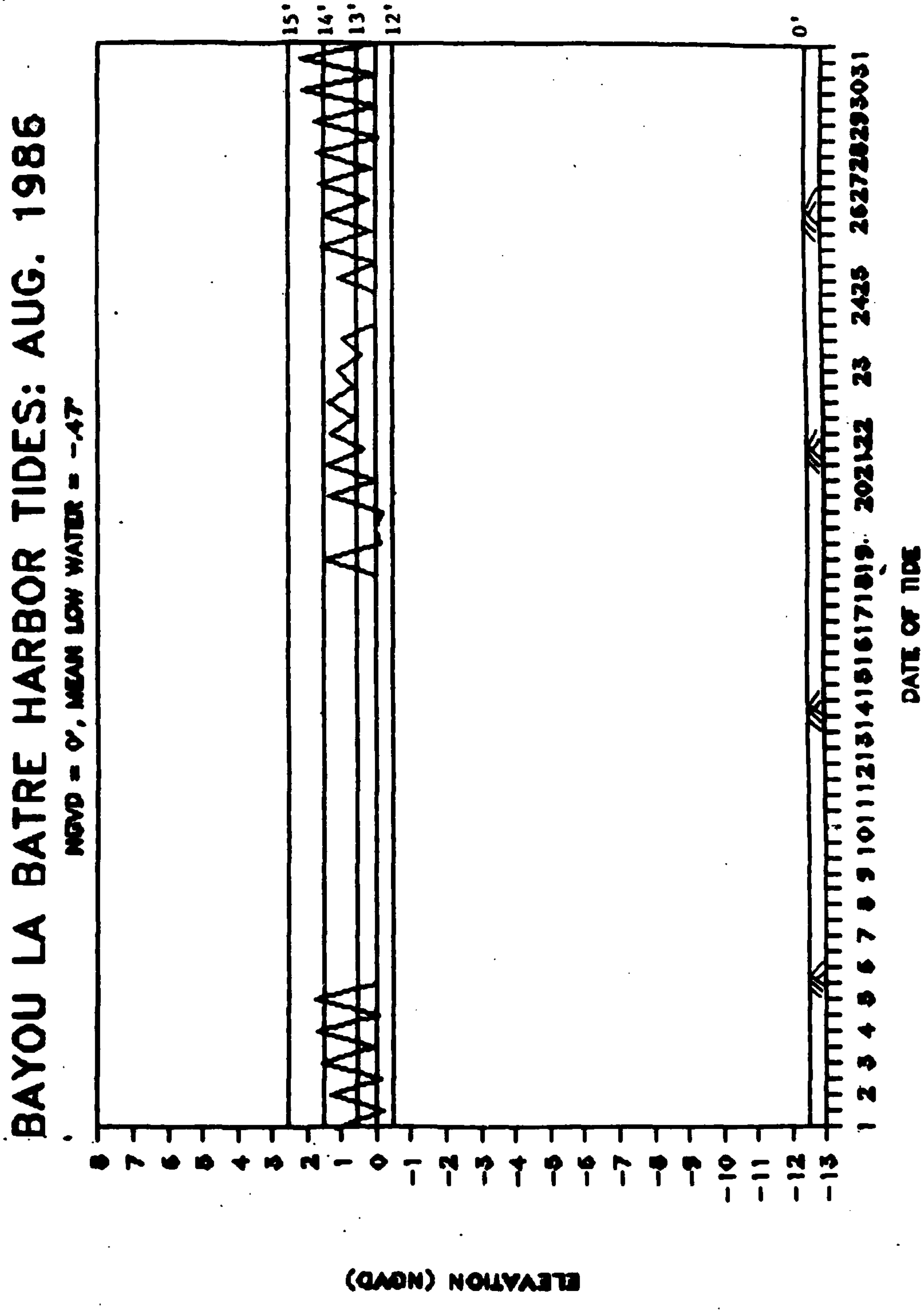

Figure 11
Tide Elevations, Aug. 1986

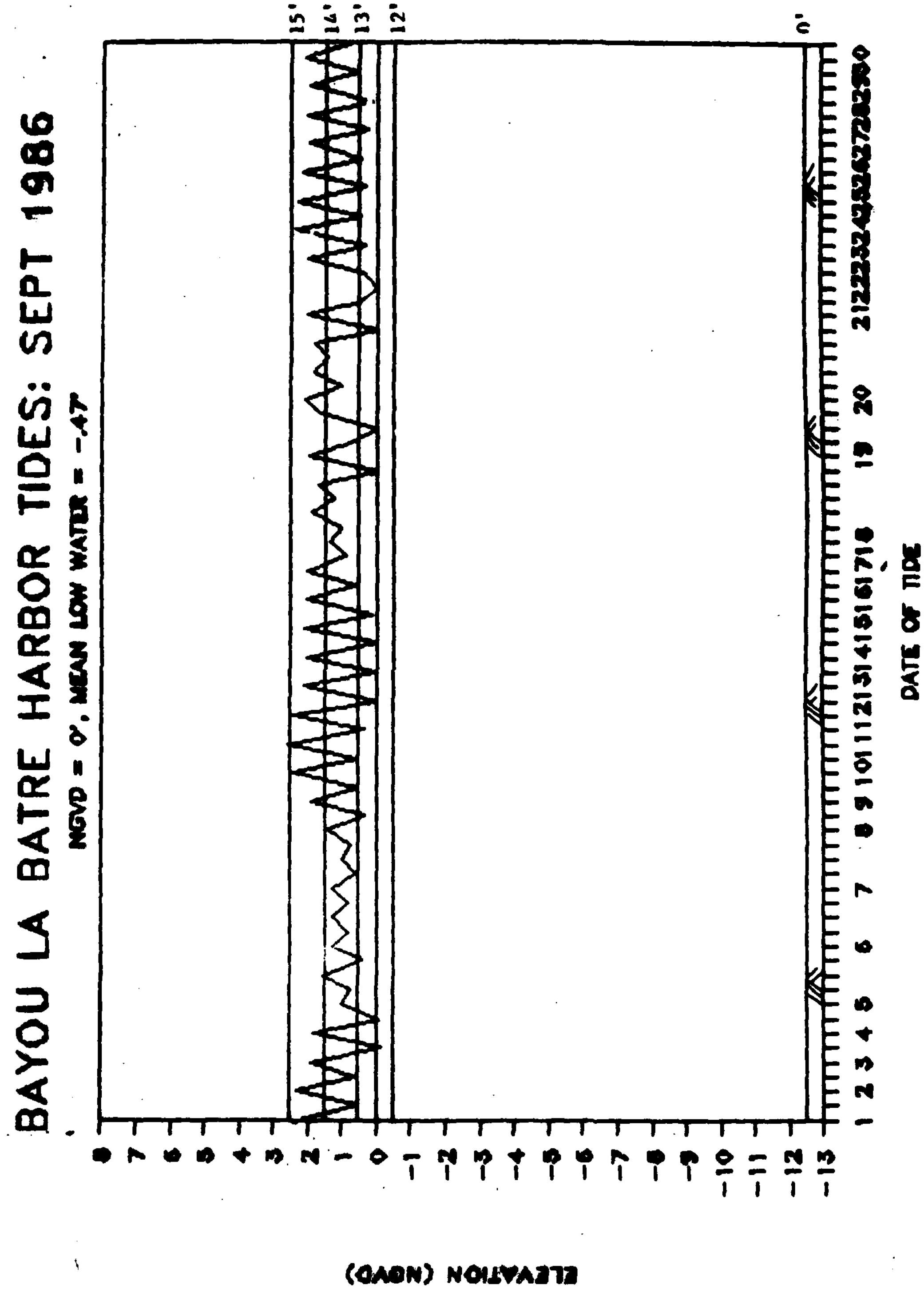

Figure 12
Tide Elevations, Sept. 1986

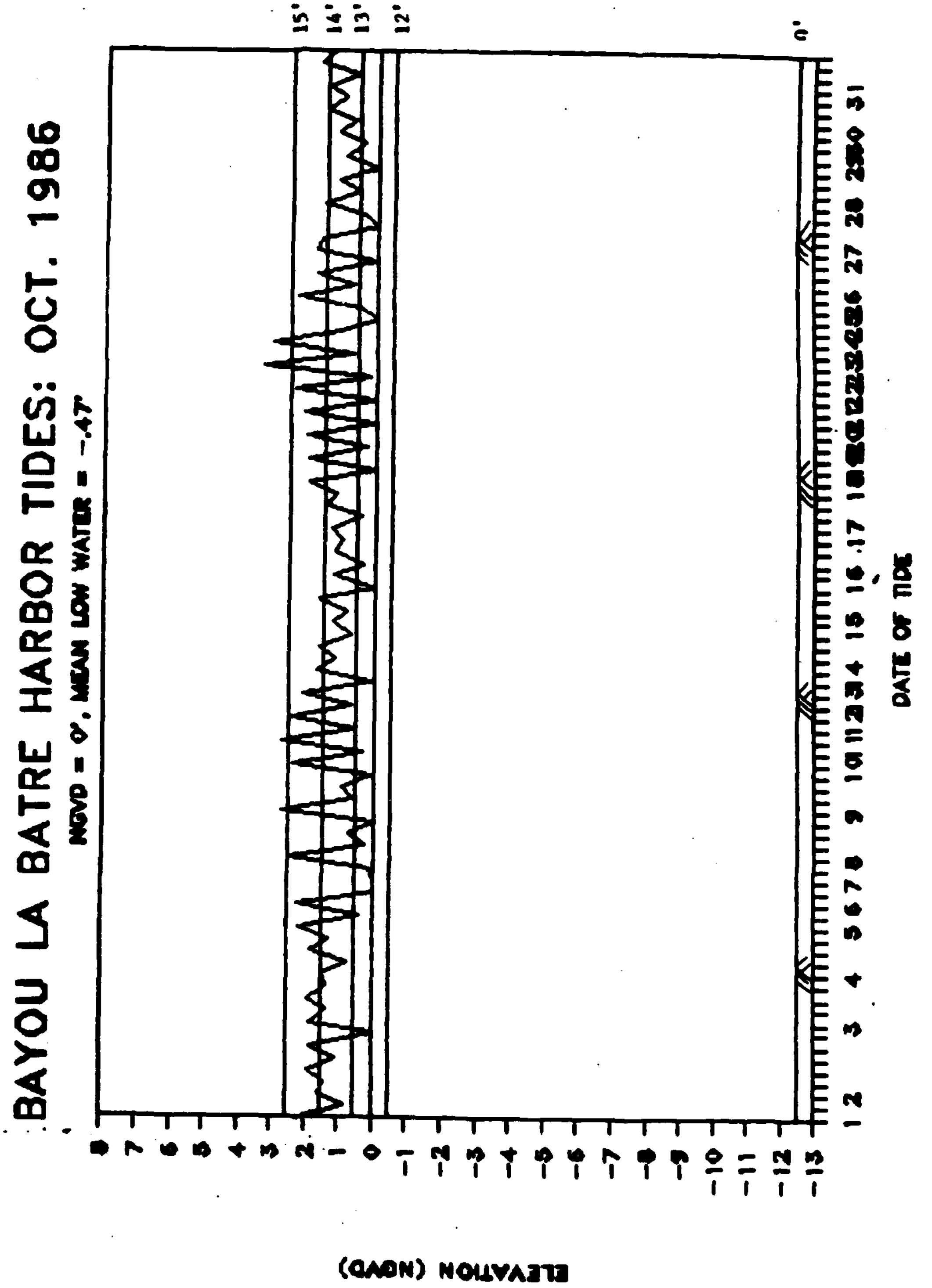

Figure 13
Tide Elevations, Oct. 1986

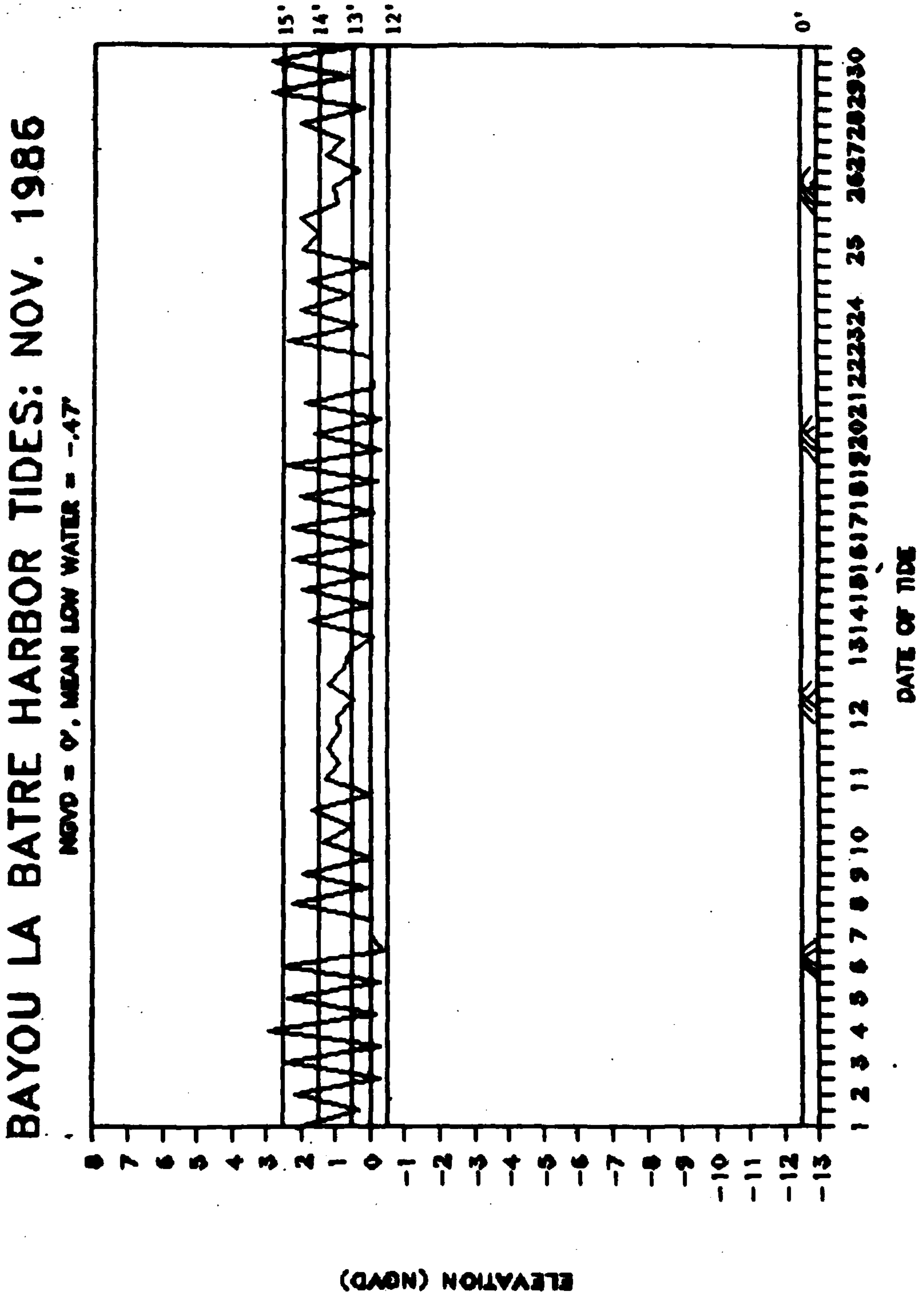

Figure 14
Tide Elevations, Nov. 1986

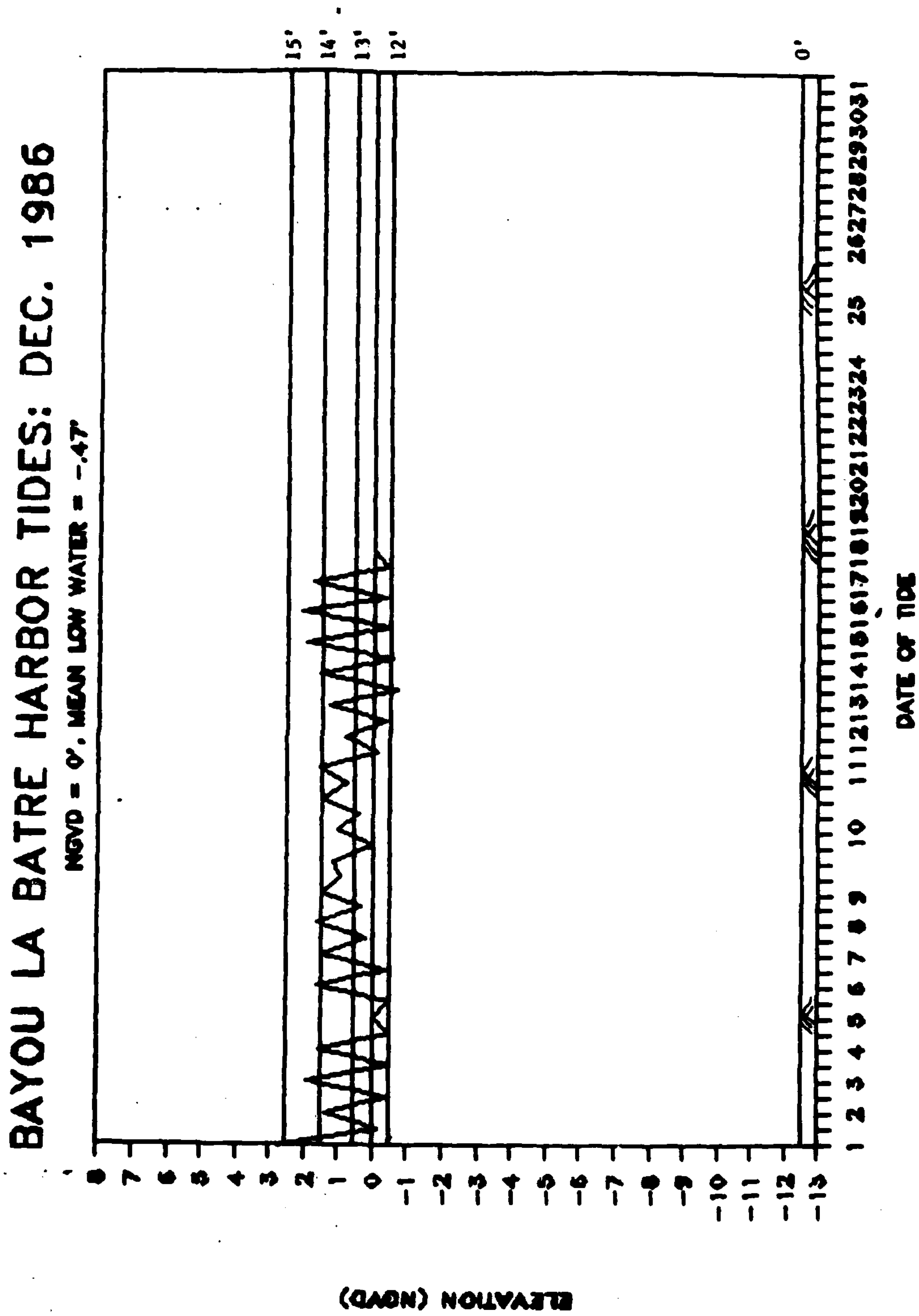

Figure 15

Tide Elevations, Dec. 1986

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25/ "Gulf butterfish could spread from reject to catch of gold" The Fish Boat, March 1986, pp. 24-25.

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32/ loc. cit., pp. 81-86.

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APPENDIX C

INSTITUTIONAL, FINANCIAL AND COST RECOVERY ANALYSIS

TABLE OF CONTENTS

__Appendixes:__

1.0 INTRODUCTION

1.1 Project Overview and Objectives

At the request of the City of Bayou La Batre, Alabama, the U.S. Army Corps of Engineers is considering deepening the channel at Bayou La Batre. The City of Bayou La Batre is located in southwestern Alabama near the Mississippi border (Figure 1-1). The Bayou drains into Mississippi Sound, and provides access to the Gulf of Mexico. The present channel depth of 12 feet restricts the movement of fishing boats, boats constructed and repaired, and various other support vessels used in offshore oil and gas exploration and in national defense. The Corps is considering deepening the channel to a depth between 14 and 20 feet, depending upon the benefit/cost analyses.

The Water Resources Development Act of 1986 (Public Law 99-662) requires that "non-Federal interests" pay a portion of the cost of constructing a harbor navigation project, such as the one planned for Bayou La Batre. For a general navigation project in a harbor having a depth of 20 feet or less, the non-Federal share would be: (a) 10 percent of the general navigation construction cost, to be paid during the period of construction; and (b) an additional 10 percent over a period not to exceed 30 years. The non-Federal interests, however, must provide disposal lands for dredged material, easements, relocations, and rights-of-way, the value of which is credited against the second 10 percent.

For harbors not exceeding 20 feet in depth, the Federal government will pay 100 percent of the costs of operation and maintenance of the project following construction. Prior to initiating the Bayou La Batre harbor and channel deepening project, the Federal government would enter into contractual agreements with the non-Federal interests which would set forth the schedule of payments of the non-Federal share.

Potential non-Federal interests or sponsors of the Bayou La Batre project are: the State of Alabama; the County of Mobile, which contains Bayou La Batre; and private firms in the Bayou La Batre area which could provide funds through a unit of government.

The analysis described in this report has four major objectives. The first is to select a specific regional economic model from a set of models developed by or for the U.S. Department of Defense that would be most suitable for application to local cost recovery analyses, particularly in the case of Bayou La Batre. The second objective is to adapt the model selected, or develop an alternative model, for use by the Mobile District Office in simulating regional economic impacts and provide a mechanism for local cost recovery. The third is to estimate the regional economic

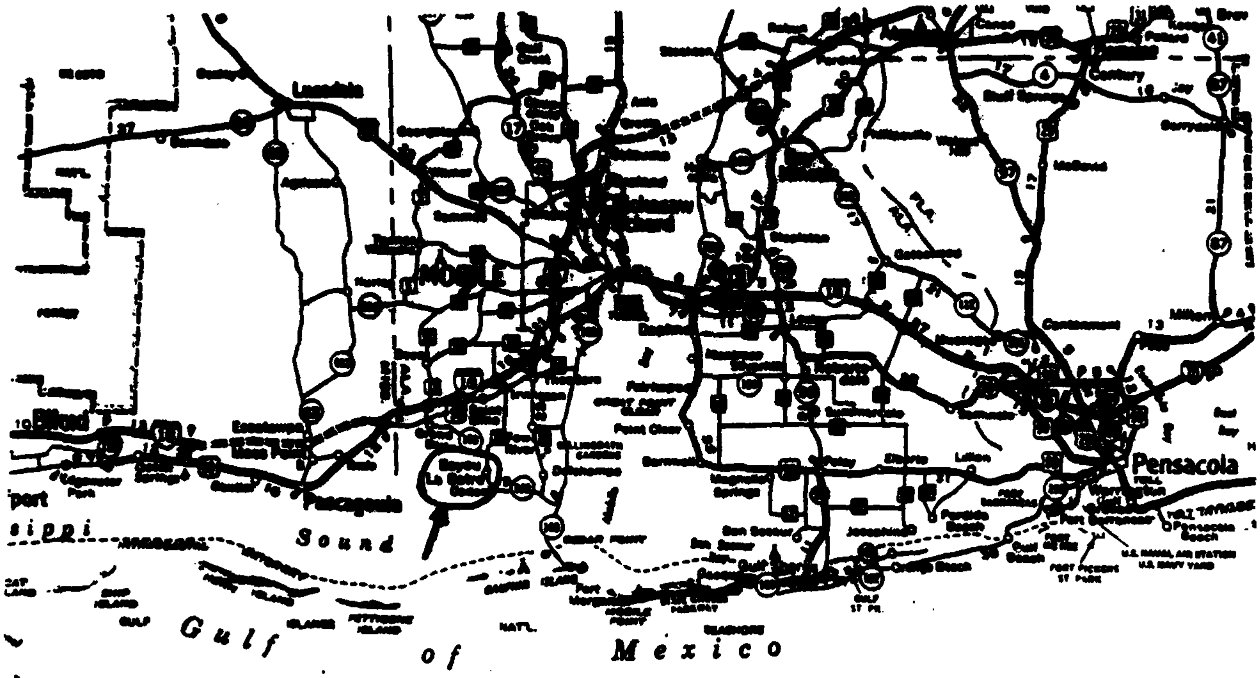


Figure 1-1: Map of Bayou La Batre Area

impact of the planned Bayou La Batre channel deepening project, including the effects on state and local government revenues. The fourth objective is to develop a plan for non-Federal cost sharing and cost recovery that meets the requirements of the Water Resources Development Act of 1986.

1.2 Plan of the Report

Section 2 presents an overview of the Bayou La Batre harbor and proposed channel deepening project, and of the economy of Bayou La Batre. The industries which comprise the economic base of the local economy--commercial fishing, seafood processing, and shipbuilding and repair--are discussed in some detail.

Section 3 presents a review of four regional economic models developed by the Corps of Engineers and other units in the Department of Defense, plus three additional models developed by other organizations. One of the models is recommended for use by the Mobile District. Section 3 satisfies the first objective of the study.

Section 4 describes a regional economic impact model developed by STRATEGICA which meets the requirements of the Mobile District more fully than the existing models. The STRATEGICA model relies on parameters developed in other models available to the

Mobile District. But the model is easier to use, is available for use on a personal computer, and provides estimates for each year of a project's operational life. Estimates of the regional economic impacts of the proposed Bayou La Batre project are reported in summary form. Section 4 satisfies the second and third objectives of the study.

Section 5 presents the cost-recovery analysis. Potential state and local government sources of non-Federal cost-sharing are identified; a financing plan is developed; and the opportunities for cost recovery are discussed. Section 5 satisfies the fourth objective of the study.

Appendix A contains the specifications for the STRATEGICA regional economic impact model and the detailed estimates of the regional impacts of the planned Bayou La Batre project. Appendix A presents further detail relating to the second and third objectives of the study.

A list of contacts made during the course of the project appears in Appendix B. The references and bibliography listings are shown in Appendix C. A glossary of terms is listed in Appendix D.

Numbers in parentheses ( ) refer to entries in Appendix C, References and Bibliography.

2.0 THE BAYOU LA BATRE ECONOMY

2.1 Introduction

Bayou La Batre is a city of about 2,200 persons located in southwest Mobile County, Alabama (Figure 2-1). Although the population of the city was quite stable for many years, outmigration occurred in the late 1970's due primarily to the recession in offshore oil drilling. Population growth has resumed in the 1980's however.

Table 2-1 compares recent population changes in Bayou La Batre and Mobile County and the State of Alabama. Note that population growth continued in both the County and the State in the 1970's while Bayou La Batre was experiencing outmigration. From 1980 to 1984, population in Bayou La Batre grew faster than did Mobile County or the State. Nevertheless, Bayou La Batre remains a very small town; its population represents only about 1/2 of one percent of the Mobile County total.

The major industries in Bayou La Batre are commercial fishing, seafood processing, and shipbuilding and repair. There is also an apparel manufacturer employing about 500 persons. Total employment in Bayou La Batre is estimated at 5,000 (1). Since employment exceeds population by a factor of nearly 2.5, there is considerable inmigration into Bayou La Batre during the work day. The residential distribution of the City's workers is not known with precision; some live elsewhere in Mobile County, others live in other Alabama counties, and still others live in Mississippi, which borders Mobile County.

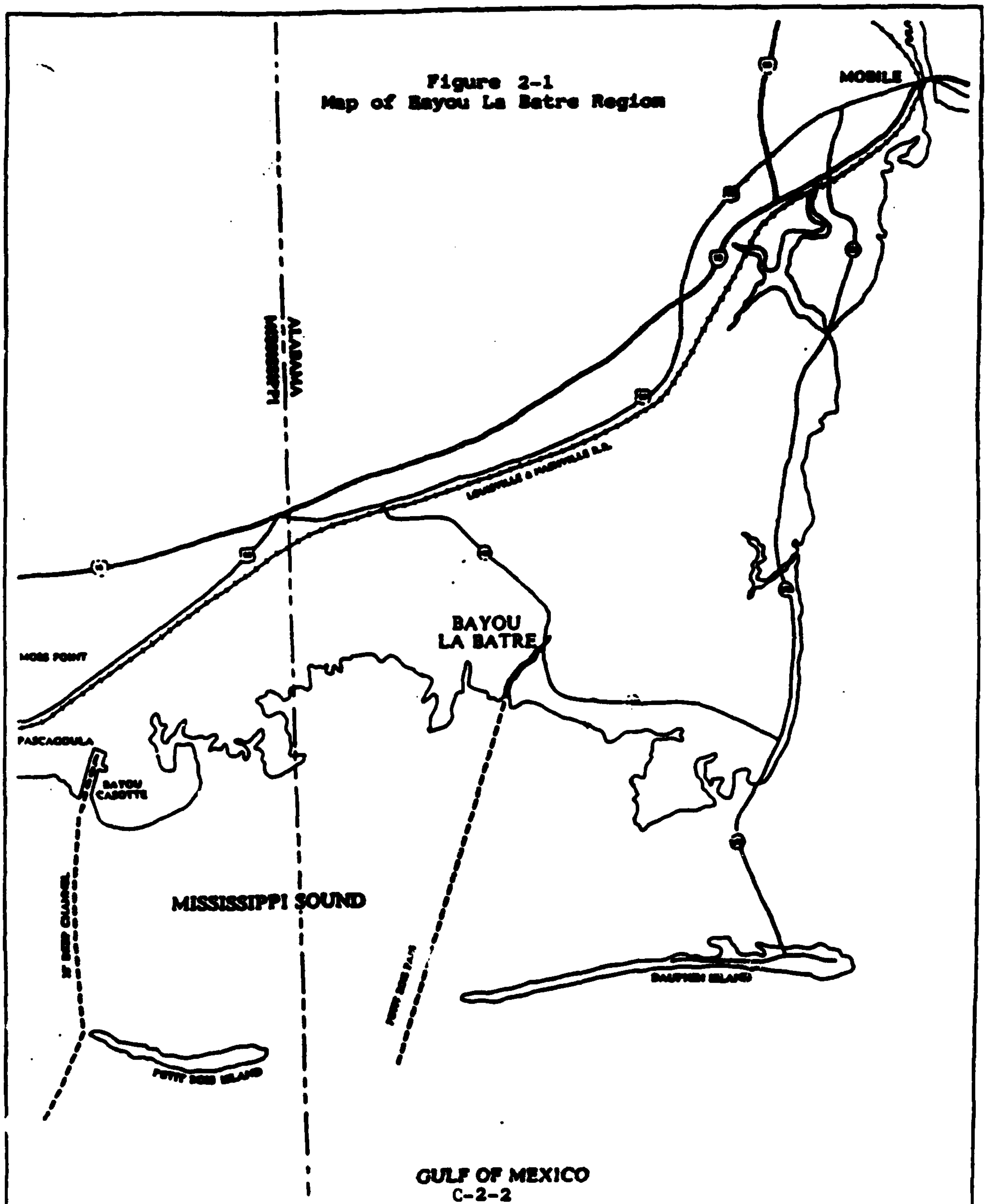
Table 2-1
Population, Bayou La Batre, Mobile County, and Alabama
1970, 1980, and 1984

	1970	1980	Percent Change 1970-80	1984	Percent Change 1980-84
Bayou La Batre	2,664	2,005	-24.7	2,162+	7.8
Mobile County	317,308	364,980	15.0	378,800	3.8
Alabama	3,444,165	3,893,888	13.1	3,990,221	2.5

+ Excludes some uncounted Vietnamese immigrants.

Source: Bureau of the Census, U.S. Department of Commerce, as reported in Mobile District, U.S. Army Corps of Engineers, Benefit-Cost Study for the Bayou La Batre Harbor and Channel Deepening Project (Draft), 1987.

Figure 2-1
Map of Bayou La Batre Region



The maritime industries which form the economic base of Bayou La Batre will be the direct beneficiaries of the proposed harbor and channel deepening project. The following paragraphs discuss each of these industries in some detail.

2.2 Shrimping and Shrimp Processing

Seafood and fish consumption has grown rapidly during the past decade. Shrimp is one of the shell fish that has gained in popularity during this time. According to Vondruska, Otwell, & Martin, "in dollars, breaded shrimp and raw headless shrimp are the leading items for U.S. processors" (2).

The small fishing village of Bayou La Batre is an important economic center for landing and processing shrimp. It is third in the Gulf of Mexico ports in "total value of shrimp landings." The 1986 landing of 14,500,000 pounds of heads on shrimp was valued at $36,700,000 (1). In 1986, 42,504,000 pounds of heads on shrimp were processed in Bayou La Batre for a total worth of approximately $108,400,000, according to Ted Flowers of the National Marine Fisheries Service (NMFS).

Shrimp arrives in Bayou La Batre via two different methods: it is either landed directly from the fishing boats or it is trucked in from other ports for processing. The fleet working out of Bayou La Batre consists of 252 gulf boats which operate for as long as 2 weeks per trip, and 252 bay boats which operate for about 4 days per trip (1).

A certain amount of vertical integration exists within the shrimp industry. Several firms are engaged in building shrimp boats, operating shrimping fleets, operating shrimp processing plants, and, in some instances, distributing the shrimp in fresh or frozen form to various markets.

There is a marked trend in shrimping toward larger boats that can stay out of port for longer periods, and that can handle a certain amount of on-board processing. The larger boats are equipped with flash freezers for immediate freezing of shrimp at sea. These boats have deeper drafts than the ones that have operated out of Bayou La Batre in the past.

It is expected that the shrimp catch in the Gulf of Mexico will increase gradually over the next 30-40 years, but the maximum sustainable yield of shrimp in the Gulf will be constrained by the available biomass.

The effect of the present 12' channel depth is to restrict the movement of some of the existing shrimp boats calling at Bayou La Batre and to discourage access by the larger, deeper draft boats. Several of the shrimpers interviewed indicated that during certain periods of the year it is very difficult to use the channel, because a combination of low tides and northerly winds reduce the depth of water in the channel.

If the Bayou La Batre channel were deepened to 14' or 16', most of the problems reported for shrimp boats would be alleviated. It is likely that some of the shrimp now being trucked in from other ports for processing would be landed at Bayou La Batre if the channel were deepended, but it is difficult to estimate the magnitude of this shift.

2.3 Commercial Fishing and Fish Processing

Although shrimp is the principal fishery product landed and processed at Bayou La Batre, NMFS' Ted Flowers estimates that in 1986 approximately 1,563,000 pounds of oyster meats, 1,205,000 pounds of crab meat, and 738,000 pounds of miscellaneous fish and shellfish products were processed. The miscellaneous category includes stuffed flounder and crabs, mullet roe, and shark fins. The value of these processed products was ion excess of $14 million.

The waters of Mobile Bay and the Gulf of Mexico in the vicinity of Mobile contain a wide variety of underutilized species, such as: little tunny; blackfin tuna; Spanish sardines; thread herring; butterfish; and scad (3). Interest in butterfish has been stimulated recently by opportunities to export this product to Japan.

Bayou La Batre is also expected to participate in the national and international demand for surimi-based foods, primarily "imitation" crab. According to Mr. Dayton Graham of JAC Creative Foods (and Deep Sea Foods, Inc.), a surimi plant is now being built in Bayou La Batre and will be in operation in early 1988.

According to Vondruska, the U.S. market for surimi-based seafood products rose to approximately 70 million pounds edible weight in 1984, with Japanese made imitation crab products accounting for more than 80 percent of the total (4). Since then, overall demand for surimi products has grown to 100 to 125 million pounds, according to the National Fisheries Institute (5). The growth in surimi demand is expected to continue, but at a much slower rate. It is likely, however, that U.S. production will replace some of the imported products from Japan. Opportunities also exist for U.S. surimi producers to capitalize on certain export markets.

The fish most commonly used in making surimi is Alaskan pollock, but this species is almost fully utilized. Thus, growth in surimi production will have to be based on the utilization of other species, including some that are found in the Gulf of Mexico, such as white trout and croaker.

The limitations on commercial fishing and fish processing in Bayou La Batre are similar to those described above for shrimping and shrimp processing. The trend in commercial fishing is to larger boats with greater on-board processing. Although a certain portion of the fish processed in Bayou La Batre will always

be trucked in, there is reason to expect that a deepened channel will generate additional landings of a wide variety of fish.

As with shrimpers, it appears that deepening the channel to 14' or 16' would accomodate most of the needs of commercial fishing boats.

2.4 Ship and Boat Construction, Conversion, and Repair

Despite its small size, Bayou La Batre has a substantial ship building and repair industry. The principal ships manufactured are shrimp and fishing trawlers, tugboats, barges, drydocks, oil supply vessels, and surveillance support vessels. These are produced by approximately 16 firms in the Bayou La Batre area, most of which are located on the Bayou itself.

According to Palmer and Baker, "Shipbuilding of U.S. registered vessels constructed in Bayou La Batre during the period 1975-1984 was 1,040 with a total value of $495,200,000. This does not include vessels constructed for export tc foreign countries, which represents 198 vessels, with a value of approximately $82,400,000. The total value of vessels constructed in Bayou La Batre during the period 1975-1984 is approximately $577,600,000" (6).

The experience of Master Marine appears to be indicative of the future, "The trend in our new construction has been moving toward larger, deeper draft fishing trawlers for export and larger, deeper tugboats and oil supply vessels for work further offshore along the U.S. Gulf Coast" (7). Several of the boat builders have been successful in making sales of fishing boats to firms in Central and South America, Africa, and India. (See, for example, the listing in The Fish Boat, December, 1986) (8). Commercial fishing is growing rapidly in developing countries, and the Bayou La Batre industry seems well poised to tap this expanding market.

In addition to boat building, the yards in Bayou La Batre have been actively engaged in conversion of vessels from oil supply to fishing configurations, and from one type of fishing to another.

Boat builders would like to see the Bayou La Batre channel made as deep as possible. With each added foot of depth certain new market opportunities are created. The U.S. Coast Guard, for example, requires a guaranteed 18' depth for bidding on construction and repair of its vessels. Certain conversions require channel depths in excess of 16'.

Based on the interviews with boat builders, a channel depth of 18' would satisfy most of the identified needs. Of course, a 20' channel would be preferred by the boat builders if the added project construction funds can be found. A channel of greater than 20' in depth would not be cost-effective from the standpoint

of the non-Federal sponsor, because of the increased non-Federal share required by the Water Resources Development Act of 1986.

2.5 Other

Opportunities also exist in the Bayou La Batre area for containerized shipping and for expanded support of the Gulf's oil and gas exploration and production activities. The location of Bayou La Batre, the availability of productive, non-union labor, and the mix of entrepreneurial skills favor such developments.

For all of these applications, a deeper channel would be a major asset. Channel depths in the range 18'-20' should meet most needs.

3.0 REGIONAL ECONOMIC MODELS

3.1 Introduction

Economic models are used to forecast regional economic activity, to assess the impacts of public or private investents, and to evaluate public policies. This section will first review several generic types of regional economic models, then discuss seven specific models available to the Corps for use in estimating the economic impacts of water resources projects.

3.2 Types of Models

A regional economy is a macroeconomy for a subnational regional area. Thus most regional models are based upon macroeconomic theories. In general, macroeconomic equilibrium is given by the expression (9):

$$Y = A \ / \ s(1-t)+t+x$$

where: Y = the equilibrium level of income or GNP
A = planned autonomous spending
s = the marginal propensity to save
t = the income tax rate
x = the marginal propensity to import

The numerator of the equation represents autonomous (*i.e.*, not related to income) injections to the flow of income, and includes autonomous consumption, investment, government spending, and exports. The denominator is the "leakage rate": the propor-ſon of each dollar injected which is not respent because of savings, taxes, and imports. The ratio 1/leakage rate (= k) is the "multiplier". For example:

Let $A = \$500$ billion; $s = 0.1$; $t = 0.2$; and $x = 0.1$;

then $Y = 500/0.38 = \$1{,}315$ billion

and $k = 1/0.38 = 2.63$ (each dollar of autonomous spending is multiplied 2.63 times to determine the equilibrium level of income)

The multiplier, k, is important because any change in an autonomous expenditure will be "multiplied" through respending to produce a larger change in total GNP.

Respending occurs when recipients of the income produced by autonomous spending purchase goods for their own consumption. These purchases produce additional income which is also partially respent. Only partial respending occurs because some of the additional income is used to pay taxes, part is saved, and part

is spent on imported goods. Respending repeats itself, becoming smaller and smaller with each round, until it approaches zero.

In the national economy the largest injections are investment and government spending; the largest leakages are savings and taxes (although exports and imports are becoming more important injections and leakages for the U.S. economy).

The macroeconomic model outlined above also applies to regions, but with several differences. First, regional autonomous spending is normally defined as spending that comes from outside the region. This includes most federal government expenditures in the region, as well as purchases of goods and services produced in the region but sold to consumers and businesses in other regions (for example, agricultural commodities, manufactured goods, and tourism services). Exports are a far greater proportion of a region's economy than of the nation's economy -- so much so that most models treat regional exports as the most important component of regional autonomous expenditures.

Businesses and consumers living in a given region also devote a high proportion of purchases to imports from other regions. Goods purchased in local retail outlets, for example, often were manufactured outside the region. Thus only a small portion of each dollar spent remains in the region for further respending (i.e., the retailer's markup); the rest "leaks" into other regions. This means that, in regional models, the propensity to import is a very important component of the leakage rate. Further, the smaller the region, the higher is the propensity to import -- with the result that regional multipliers vary directly with the size of the region.

Because of the importance of regional exports and imports, many regional models focus on estimating the economic impact on a region of a given change in regional autonomous expenditures (often termed "export demand", "external demand" or "final demand"). These regional models stress the estimation of regional multipliers and are less concerned with estimating total regional economic activity. Three widely-used types of models are outlined in the following paragraphs.

3.2.1 Economic Base Models

Economic base models (10) divide a regional economy into two sectors: "basic" or export industries; and "nonbasic" industries. Output (or income or employment) in basic industries is considered to be determined by forces outside the region; output in nonbasic industries is treated as resulting from the respending of income produced by the basic industries. The regional economy is thus driven by the autonomous (external) demand for its exports.

In its simplest form, an economic base model assigns agriculure, mining, manufacturing, and federal government to the

basic sector; construction, transportation and public utilities, wholesale and retail trade, finance, services, and state and local government to the nonbasic sector. The regional multiplier is the ratio of total output to basic output (regional models often use income or employment multipliers instead of output multipliers). More careful studies assign some basic sector activities to the nonbasic sector (production of food for local consumption by local food processors, for example) and some nonbasic sector activities to the basic sector (hotels and motels, for example).

This type of model accounts only for "forward linkages" in the regional economy, however. That is, the respending of the earnings of, say, a factory worker, in local trade and service industries are accounted for. But "backward linkages" are omitted. Backward linkages occur when an increase in the external demand for a locally-produced good or service results in the local producer purchasing additional inputs from other industries in the region (for example, if an increase in the external demand for locally-manufactured blue jeans resulted in the blue jean manufacturer purchasing denim cloth from another manufacturer in the region).

A more sophisticated form of economic base model addresses this problem. For each industry in the region, the percentage of total regional output (or income or employment) accounted for by the industry is compared to the corresponding national percentage. If the regional percentage exceeds the national percentage, the region is assumed to be an exporter of the industry's product, and the excess is assigned to the basic sector. (For example, if 12 percent of a region's employment is in industry i, while only 9 percent of U.S. employment is in industry i, 1/4th of the region's employees are assumed to be basic.) This method of assigning output, income, or employment to the basic and nonbasic sectors is called the Location Quotient technique (11). The regional multiplier is again the ratio of total output, income or employment to basic output, income, or employment.

The Location Quotient technique accounts for both forward and backward linkages because some output in every industry (up to the corresponding U.S. percentage of total output) is nonbasic, and thus responsive to changes in basic output.

Economic base models are used to estimate the total regional impacts of changes in demand in the basic sector. The basic sector changes themselves must be estimated by some other technique (such as a regional econometric model, discussed below).

Economic base models, even those based upon the Location Quotient technique, have important limitations. First, economic base models do not differentiate the effects of specific changes in external demand. Second, the assignment of activity to basic

and nonbasic sectors is sensitive to the level of industrial detail. Finally, economic base models do not provide for cross-hauling.

It is likely that an increase in the external demand for the output of a highly automated regional manufacturer which purchases its inputs outside the region will have a smaller impact on total output, income, and employment in the region than would an increase in the external demand for a labor-intensive manufacturer which purchases most of its inputs within the region. Economic base models estimate a single multiplier and hence cannot differentiate between different kinds of changes in external demand. Regional input-output models, to be discussed below, are designed to produce separate multipliers for each regional industry.

The greater the level of industrial detail, the greater will be the quantity of regional output, income, or employment assigned to the basic sector. A region may have less than the national percentage of its employment in Food and Kindred Products (Standard Industrial Classification (SIC) Code 20), for example, and hence have no basic employment if the industry is examined at the 2-digit SIC level of aggregation. But the percentage of regional employment in SIC 2092, Fresh or Frozen Packaged Fish, may well exceed the national average. Thus to accurately assign employment to the basic and nonbasic sectors, the most disaggregated level of industrial data should be used. Even if 4-digit SIC data (the most disagregated data available from secondary sources) are used, however, too few employees and too little income will be assigned to the basic sector (12, p. 8). This will result in a regional multiplier which is too high. The major reason for this is that cross-hauling is not accounted for.

Cross-hauling occurs when part of the output of a regional industry is exported to other regions, while at the same time, the output of the same industry in imported from other regions. Suppose for example that a region has an automobile assembly plant (SIC 3711) producing, say, Chevrolet Corvettes. As long as the percentage of regional employment in SIC 3711 does not exceed the national average, none of the region's output, income, or employment in SIC 3711 will be assigned to the export sector using the Location Quotient technique. In reality, of course, nearly all of the Corvettes are exported, and most automobiles purchased by regional residents are imported. The problem is that the Location Quotient technique assumes that all output of regional producers is used first to satisfy regional demands; only the excess is assumed to be exported. Similarly, all regional demand for the output of any industry is satisfied first by producers in the region; only demand in excess of regional output is assumed to be imported.

It might be thought that the solution to the cross-hauling problem would be to return to the simpler technique of merely

classifing industries as totally basic or nonbasic. Leven (13) found, though, that in many regions traditionl basic industries such as manufacturing have been declining, while nonbasic industries have been expanding. The economic base multipliers in such regions would be negative.

3.2.2 Input-Output Models

An input-output model (see 14, 15, and 16 for more complete treatments) begins by examining each industry in a region to estimate its purchases of inputs: from each other industry in the region; from industries outside the region; and from households within the region (i.e., its purchases of labor services). The estimates are expressed in terms of purchases per dollar of output, or technical coefficients. (As a simplified example, each dollar of output produced by a mobile home manufacturer might require 20 cents of input from a regional fabricated metal manufacturer, 15 cents of input from a regional plastics manufacturer, 1 cent of input of regional business services, 25 cents of inputs from businesses outside the region, and 39 cents of labor.)

An input-output model also includes one or more final demand sectors: the output required from each industry to meet regional export demand and to satisfy consumer demand within the region. Each dollar of final demand for the output of a given industry creates additional demands for output in the industries supplying inputs to the given industry. The production in the supplying industries in turn creates additional demands for outputs in the industries which supply the suppliers. The process repeats itself until all the direct and indirect effects of the initial dollar of final demand have been met. The total output in all industries necessary to produce a dollar's worth of output in the given industry is the regional output multiplier for that industry. The total payments to households in all industries required to produce a dollar's worth of output is the regional earnings multiplier for the industry. Finally, the total employment in all industries required to produce a dollar's worth of output in the given industry is the regional employment multiplier for the industry.

Input-output models do not produce estimates of final demand. Thus they cannot be used for forecasting regional economic activity unless a separate estimate of final demand is available or developed by another model (such as a regional econometric model, discussed below). Thus input-output models, like economic base models, are most useful for estimating the impacts of expected changes in components of final demand.

The major advantage of input-output analysis is that it produces separate multipliers for each industry, as compared to the single multiplier provided by economic base analysis. There are several disadvantages, however, related to the costs of developing an input-output model, and the realism of the assumptions of the model.

To develop an accurate input-output model for a region, a very large sample of business firms must be interviewed to determine the distribution of their input purchases and sales of output among industries both inside and outside the region. This information is used to estimate the technical coefficients which are the heart of the model. The interviews must be repeated every few years because changes in technology, changes in input prices, and changes in sources of supply and demand will change the technical coefficients over time. The enormous expense of creating and updating an input-output model using survey techniques has led to the development of various nonsurvey methods for developing regional input-output models.

Nonsurvey methods generally begin with a national input-output table of technical coefficients, such as the one developed by the U.S. Department of Commerce (17). It is usually assumed that the input requirements for a given industry are the same in the region as in the nation as a whole. This means that "possible differences in the age of the capital stock, the size mixture of firms within a sector, differences in technology, (and) possible variations in product mix ..." (16, p. 47) are ignored. The errors resulting from this assumption will increase with the level of industrial aggregation and decrease with the size of the region. That is, the input requirements for a narrowly defined industry (i.e., "fresh or frozen fish", a four-digit SIC industry) in a large region are likely to be more similar to the national average than the input requirements for a broadly defined industry (i.e., "food and kindred products", a two-digit SIC industry) in a small region.

Assuming that the menu of input purchases for each industry in the region is identical to the corresponding national menu, the regional source of each industry's purchases of each input must be estimated. To the extent that inputs are purchased from other firms within the region, there will be further economic impacts within the region. Inputs purchased outside the region create no further regional effects. Thus, for each industry, the proportion of each input purchased from another industry within the region must be estimated. These proportions are called <u>regional purchase coefficients</u>.

The simplest approach to estimating regional purchase coefficients is to simply assume that the total output of each industry is used first to satisfy the input requirements and consumer demands of other industries and households within the region; the excess, if any, is assumed to be exported. If the total demand within the region exceeds regional production, the excess is assumed to be imported. This method is similar to the location quotient technique used in economic base models, and suffers from the same cross-hauling problem. If industries within a region buy a given input from firms outside the region, while at the same time producers of the input within the region sell to buyers outside the region, the location quotient technique will not detect the cross-hauling, and will assume that regional

industries are buying the input from the regional producers. (This could easily occur if the input needs within the region were for a different type of product -- within the same industrial classification -- than that produced by the regional supplier.) The result of this error would be overestimation of regional multipliers.

More sophisticated techniques for estimating regional input-output coefficients and regional purchase coefficients from non-survey data have been developed (18). These techniques allow for both variations in input requirements among regions and cross-hauling, and thus improve the accuracy of input-output multipliers.

The technical coefficients in national input-output models also change over time; yet because of the time and resources required to re-estimate the national tables, they are updated only every decade or so. Thus regional models based upon national technical coefficients are subject to a further source of error. However, methods of adjusting technical coefficients over time can be used to reduce this source of error (telephone interview with Benjamine H. Stevens, Regional Science Research Institute, November, 1987).

The use of regional input-output models based upon non-survey (or partial survey) methods is growing rapidly. Although they cost far more than economic base models to develop and maintain, input-output models generate industry-specific multipliers that are thought to be more accurate and more useful than the single multipliers produced by economic base models. The best regional input-output models are those that use highly disaggregated industries and estimate regional purchase coefficients with methods that allow for cross-hauling and differences in technical coefficients. Even these models, though, are far more accurate for large regions, such as states, than they are for small regions such as counties.

3.2.3 Econometric and Other Models

Economic base and input-output models calculate the impacts on regional economies of exogeneous changes in regional exports (economic base models) or final demand (input-output) models. Thus they are most often used to estimate the effects of specific anticipated changes such as the introduction of a new manufacturing facility or public-sector project (i.e., a water resources project). If an economic base or input-output model is to be used to forecast total regional economic activity, another technique must be used to forecast regional exports or final demand.

Econometric models are systems of equations describing the economic structure of a region. They contain both regional and national economic variables, many with time lags. Their coefficients are estimated by regression analysis and more complex

statistical techniques. An econometric model can be used to forecast regional economic activity and to estimate regional multipliers. Frequently, an econometric model is used in conjunction with a regional input-output model: the econometric model forecasts final demand; and the input-output model estimates regional output, income, and employment by industry.

Another group of models used to forecast either final demand or total regional economic activity are time series models. These models include classical time series models, which divide a historical data series (such as employment in a given industry) into seasonal, cyclical, and trend components -- and generally forecast by trend extrapolation. More sophisticated time series models, such as Box-Jenkins and Vector-Autoregressive (VAR) models, forecast future values of each economic variable by regressing historical values of the variable against lagged values of the same and related variables. While econometric models are grounded in economic theory, time series models are not: they simply analyze the data to identify relationships, and assume that the relationships will persist into the future. An example of a VAR model developed for the state of Minnesota is provided by Litterman (19).

Because the purpose of this study is to identify the regional economic impacts of a proposed water resources project -- rather than to forecast total regional economic activity --, the remainder of this Section is devoted to input-output and economic base models. Specific examples of econometric or time series models will not be discussed.

3.3 Discussion of Specific Models

The Scope of Work for this research required the evaluation of four models developed by agencies of the U.S. Department of Defense: the Economic Impact Forecast System (EIFS); the Automated Input-Output Multiplier System (AIMS); the Air Force Region of Influence (AFROI) Model; and the Multiregional Variable Input-Output (MRVIO) Model. Because none of these models are currently available for application on a personal computer (PC), three additional models were also reviewed: the Bureau of Economic Analysis Regional Input-Output System (RIMS II); the Regional Science Research Institute PC I-O Model; and a Forecasting and Simulation (FS) Model developed by Regional Economic Models, Inc. The following paragraphs discuss each model.

3.3.1 Economic Impact Forecast System (EIFS)

The Department of the Army, with cooperation and support from the Department of the Air Force, developed EIFS in the mid-1970's. The system has been continuously enhanced over the years; this discussion is based upon the EIFS currently available (20). EIFS is an interactive computer system, and is one of several applications programs included in an "umbrella"

system named the Environmental Technical Information System (ETIS). ETIS is maintained on a computer in Champaign, Illinois, and is accessable via a telephone hookup.

EIFS is both a source of socioeconomic data and a tool for estimating economic impacts. Historical socioeconomic data on population and its characteristics, housing, employment by industry, and personal income by source can be obtained for regional configurations defined by the user. A region may be defined as any county, or any group of up to 800 counties.

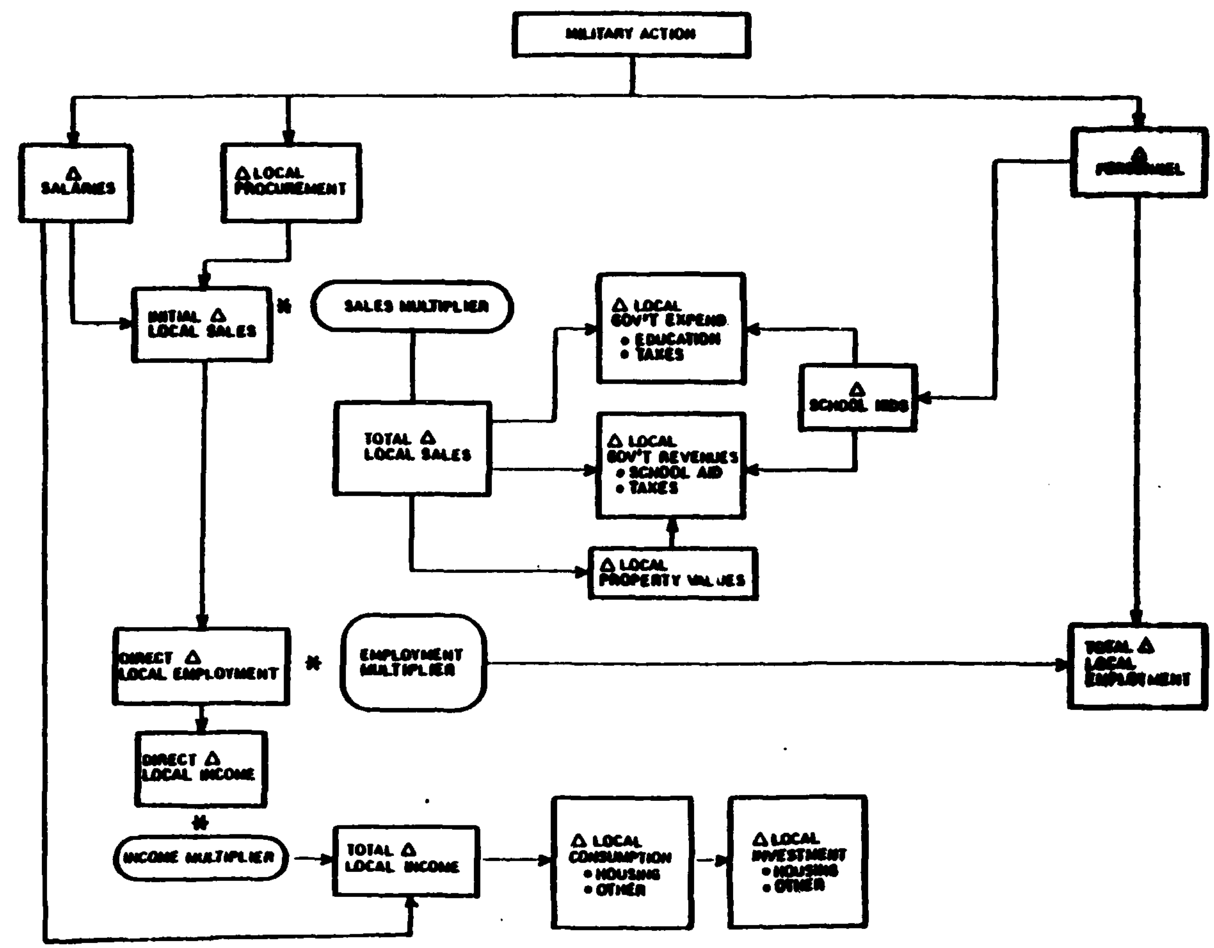
To estimate economic impacts, EIFS relies primarily on economic base multipliers, developed using the location quotient technique applied to four-digit industrial groups (20, pp. 11-12). Moreover, recent enhancement to EIFS allow the user to estimate multipliers using the Regional Industrial Multiplier System (RIMS), or using the Automated Input-Output Multiplier System (AIMS). Since these models will be discussed later, the EIFS description will be limited to the economic base model.

There are five economic impact submodels in EIFS, one for each of the five functional areas of military actions: Construction; Operations and Maintenence; Training; Mission Change; and Contractor/Industrial Type Activities. Each submodel has the general model structure shown in Figure 3-1. Changes in wages and salaries are converted into changes in local sales, which are translated into changes in direct employment and income. Local purchases by military personnel are also converted into local sales, employment and income. Employment multipliers are applied to estimate indirect employment; income multipliers are applied to estimate indirect income. Next, the total changes in local sales are used to estimate changes in local property values, taxes, and local government expenditures. Only local shares of state property taxes, and local property taxes, are estimated.

EIFS is an interactive system. The user enters the system and is prompted to supply certain information sequentially: first, the regional definition; next, the "profile" or type of information required. If the profile "forecast models" is selected, the user will next be prompted for the submodel (with or without deflation of nominal dollar data); then for certain additional information. For example, the Construction submodel requires the user to specify either the dollar volume of the construction or the local expenditures, the percentages to be spent on labor and materials, the number of military families moving on-post from the region, and the average income of affected military personel. A hypothetical construction project impact is shown in Figure 3-2.

The strengths of EIFS are ready access (the Mobile District Corps of Engineers staff is connected to EIFS via computer terminals), relative ease of use, and the reasonable estimates of economic impacts provided by the system. Its shortcomings

Figure 3-1
Flow Chart for the EIFS Forecast Model



Source: D. P. Robinson, J. W. Hamilton, R. D. Webster, and M. J. Olson, Economic Impact Forecast System (EIFS) II: User's Manual Updated Edition, CERL Technical Report N-69 (Revised), May 1984, p. 54.

Figure 3-2
Sample Output For an EIFS Forecast

```
Forecast Models - which functional area?  (<cr> to see list): 1

CONSTRUCTION

Project name:  Construction FA Example
If entering total expenditures, enter  1
            local expenditures, enter  2  : 1
Dollar volume of construction project:  $10,000,000
Local expenditures of project:  5287797.50 (calculated)
Percent for labor:  35
Percent for materials:  40
Percent allowed for other:  25.00 (calculated)
Number of military families to move onto base from local region:  23
Average income of affected military personnel:  $15,500

********** CONSTRUCTION IMPACT FORECAST FOR Construction FA Example  **********

Export employment multiplier:                         2.1221
Export income multiplier:                             1.7604
Change in local
  Sales volume ............... Direct:  $         3,598,000
                              Induced:  $         4,038,000
                                Total:  $         7,636,000   (    0.451%)
  Employment ..... ........... Direct:                  296
                                Total:                  408   (    0.277%)
  Income ..................... Direct:  $         2,424,000
               Total (place of work):  $         2,840,000   (    0.303%)
          Total (place of residence):  $         2,907,000   (    0.254%)
  Consumption ............... Housing:  $           507,000
                          Non-housing:  $         1,831,000
  Investment ................ Housing:  $           236,000
                          Non-housing:  $           220,000
  Number of school children ........ :                  -22   (   -0.024%)
  Property values ..................    $         6,773,000   (    0.451%)
  Government revenues ......... Taxes:  $           382,000
     State and federal aid to schools:  $           -14,000
  Government expenditures ... Schools:  $            -6,000
                                Other:  $           236,000
                                  Net:  $           230,000
```

Source: D. P. Robinson, J. W. Hamilton, R. D. Webster, and M. J. Olson, Economic Impact Forecast System (EIFS) II: User's Manual Updated Edition, CERL Technical Report N-69 (Revised), May 1984, p. 60.

are that EIFS is not available for use on a PC, that its estimated impacts are "timeless" (that is, impacts are not estimated year-by-year), and that tax impacts are estimated only for property taxes and only for local governments.

3.3.2 Automated Input-Output Multiplier System (AIMS)

The AIMS model is now available as a subsystem of EIFS (21, 22). AIMS is a system for generating regional input-output multipliers by nonsurvey techniques augmented by regional data. The user can generate output, earnings, and employment multipliers for 517 industrial sectors or aggregates of sectors. Regions are specified by the user, and may include one or more counties as in EIFS. An example of AIMS output is shown in Figure 3-3.

A comparison of AIMS multipliers with multipliers produced by a partial-survey input-output model of Mississippi, and with multipliers produced by the Bureau of Economic Analysis' RIMS-II system, indicated that AIMS multipliers were within reasonable percentages of multipliers produced by other input-output models (21).

The AIMS multipliers are likely to be more accurate than the economic base multipliers used in the main EIFS forecasting system. But the AIMS sub-system produces only output, income, and employment multipliers; it does not fully model the economic impact of a given change in expenditures, as does the main EIFS model. For example, AIMS does not estimate effects on local tax revenues, which are particularly important in local cost recovery studies.

3.3.3 Air Force Region of Influence (AFROI) Model

The AFROI model (23) is an interactive system, used to estimate both the region impacted by a given action and the magnitude of the impact. AFROI is maintained in the same "umbrella" Environmental Technical Information System (ETIS) as is EIFS, and so is accessible to EIFS users.

The user of AFROI selects a "boundary region": a group of counties large enough to absorb all of the regional economic impact of the proposed mili[illegible]ion. The user also provides some additional input about the size and nature of the action, about the economies of each county (the latter may be obtained from EIFS), and about the distances between the counties.

AFROI then applies a gravity-potential model to allocate direct expenditures among counties in the boundary region. A gravity potential model estimates a given interaction between two places as a direct function of the size (or other measure of "attraction") of the places, and an inverse function of the distance between the places. This step estimates the "region of influence" (ROI).

Figure 3-3
Example of AIMS Output

******* AIMS Multiplier Computations (1977 IO table) - 3 IO Codes ******

Direct Effect (DE)		0.756465
Goods and Services Purchased Locally	0.322763	
Labor Hired Locally	0.433702	
Indirect Effect (IE)		0.632979
Agr Share of Local Non-Govt Earnings (P1)	0.001831	
Mfg Share of Local Non-Govt Earnings (P2)	0.330034	
Local Share of US Non-Govt Earnings (S2)	0.010444	
ln(IE) = .65 - .79*P1 - .13*P2 + .17*ln(S2) + 1.03*ln(DE)		
ln(IE)	0.457318	
Output Multiplier (Mq) = 1 + DE + IE		2.389444
Income Multiplier (Mi) = Ij + (Mq - 1)*I.		0.994522
Income per Output - Selected Industries (Ij)	0.433702	
Income per Output - Avg (I.)	0.403629	
Employment Multiplier (Me) = Ej + (Mq - 1)*E.		84.133936
Employment per Output - Selected Industries (Ej)	32.392180	
Employment per Output - Avg (E.)	37.239185	

Source: Kim M. Bloomquist, Ronald D. Webber, and Dennis P. Robinson, "An Interactive System for Generating Regional Input-Output Multipliers", U.S. Army Corps of Engineers, (forthcoming).

Next, the indirect economic impacts on each county -- in terms of sales volume, employment, and income -- are estimated using economic base multipliers from EIFS. Finally, adjustments are made to each county's impact based upon the estimated total regional impact.

AFROI was designed for Air Force use, but a generic version has now been developed and will be available January 1, 1988. The system may be used in conjunction with EIFS whenever it is important to estimate the county-by-county economic impacts of a proposed action as well as the total regional impact. AFROI requires more user-supplied inputs than EIFS and, like EIFS, is not available for use on a PC.

3.3.4 Multiregional Variable Input-Output (MRVIO) Model

The MRVIO model was developed to measure the economy-wide impact of transportation projects (24, 25). Like each of the models thus far discussed, MRVIO estimates the regional economic

effects of the construction phase of a transportation project. But MRVIO also uses the changes in relative transportation costs resulting from the project to estimate changes in trading patterns, output, employment, and income on a region-by-region basis.

Obviously, MRVIO is useful primarily for large-scale projects which result in major shipping cost savings. It has been applied to the Coosa River Navigation Project, deepening of the Baltimore and Norfolk harbors, and the Ohio River Mainstream Navigation Project (26). The model is not yet available in an interactive computer environment.

3.3.5 Bureau of Economic Analysis Regional Input-Output Modeling System

This system (RIMS II) provides a comprehensive set of regional economic multipliers for virtually any region defined by one or more counties (27, 28). RIMS II is based upon the 1977 national input-output table (17), and BEA's own data series on county wage and salary data by 4-digit SIC code. Technical coefficients and regional purchase coefficients for each county were estimated using the location quotient technique. Output, earnings, and employment multipliers for 39 industries in each state are available in published form (28). Multipliers for a 531-industry disaggregation, for counties, states, or multi-county regions, are available from BEA for prices starting at $1,500 per region.

RIMS II multipliers differ slightly from the RIMS multipliers available in EIFS. The latter are based upon the original RIMS system, which used a more sophisticated (and more costly) method for estimating regional purchase coefficients (29, p. 62). The RIMS multipliers available in EIFS are based upon the 1972 national input-output table.

The advantages of RIMS II multipliers are that they are based upon a more recent national input-output table and that they are available to users not connected to the EIFS system. At the state level, RIMS II multipliers for 39 industries are available at nominal cost; at the county level, and for more disaggregated industries, RIMS II multipliers are more costly.

3.3.6 Regional Science Research Institute (RSRI) PC I-O Model

None of the models discussed thus far is currently available for use on a PC. The PC I-O model, developed by a private, non-profit organization, is specifically designed for the PC (30). It requires an IBM-compatible PC with a hard disk, a floppy disk, and 256K of core memory.

PC I-O is based upon a 494-sector national input-output table. Regional technical and purchase coefficients are esti-

mated using advanced techniques that allow for cross-hauling (31). Output may be produced for all 494 sectors, or for aggregations specified by the user. An example of aggregated output is provided in Figure 3-4.

The model is interactive, with prompts provided to the user after he/she enters the system. A number of "translators" (subsystems which provide estimates of additional economic variables beyond employment, output, wages, value added, state taxes, and local taxes) are available; others can be developed for the user.

PC I-O is a state-of-the-art modeling system developed specifically for use on a PC. Its major drawback is cost: a state model is priced at $7,500; regions made up of groups of counties are priced from $2,000 to $7,500, depending upon the population size of the region. Annual updating costs 20 percent of the purchase price each year.

3.3.7 Regional Economic Models, Inc. Forecasting and Simulation Models

Regional Economic Models, Inc. (REMI) has combined econometric and input-output techniques to develop regional forecasting and simulation (FS) models (32, 33, 34). The addition of the econometric model makes it possible to forecast total regional economic activity as well as to simulate the effects of user-specified changes.

FS models are based upon a 500-sector input-output table, and provide output data for 53 industrial sectors. They are available in either a mainframe or PC configuration. The FS system is interactive, with prompts provided to the user. A number of state governments (for example, Illinois, Wisconsin, Minnesota, and Kentucky), metropolitan governments, universities, and other organizations have purchased FS models. The cost of an FS model is negotiated with REMI.

3.4 Conclusions

The EIFS is the system of choice for estimating the regional economic impacts of Corps of Engineers water resources projects. It is available on-line to the staff of each Corps District, it is interactive and user-friendly, and it provides partial estimates of changes in local tax revenues (which are needed for local cost-recovery studies. The economic base multipliers used by EIFS are not industry-specific and hence less accurate than input-output multipliers. But EIFS will report the relevant RIMS multipliers at the request of the user. At present, EIFS is not available for use on a PC.

The next section develops a model which can be used on a PC in conjunction with RIMS multipliers obtained from the EIFS system. The model is designed to be particularly applicable in local cost recovery studies.

Figure 3-4
Sample PC I-O Output for "Region X"

A SAMPLE RUN OF "REGION X"

(EMPLOYMENT IN JOBS, NOT FULL-TIME EQUIVALENTS)
(DOLLAR FIGURES IN THOUSANDS)

	EMPLOYMENT	OUTPUT	WAGES	VALUE ADDED
AGRICULTURE	.9	11.3	3.6	4.0
AGRI. SERV., FORESTRY, & FISH	.4	7.1	3.0	3.3
MINING	1.2	119.3	28.2	74.4
CONSTRUCTION	71.4	2700.5	1237.0	2114.1
MANUFACTURING	66.4	4238.9	913.9	1578.6
TRANSPORT. & PUBLIC UTILITIES	13.0	1485.8	234.5	638.9
WHOLESALE	9.6	455.6	172.4	298.9
RETAIL TRADE	29.1	690.8	306.7	466.3
FINANCE, INS., & REAL ESTATE	7.7	539.6	129.9	371.2
SERVICES	34.3	1182.8	449.0	737.7
GOVERNMENT	.5	26.4	10.5	14.0
ADMIN. AUXILIARY	.0	.0	.0	.0
TOTAL	234.6	11457.9	3488.6	6301.5
MULTIPLIERS	1.703	1.523	1.613	1.596

WAGES-NET OF TAXES= 3106.223

ST TAXES-TOURISTS = .000
INDIRECT ST TAXES = 216.978
TOTAL STATE TAXES = 216.978

LOC TAXES-TOURISTS= .000
INDIRECT LOC TAXES= 327.732
TOTAL LOCAL TAXES = 327.732

OTHER VALUE ADDED = 2650.601
TOTAL VALUE ADDED = 6301.533

TOTAL INITIAL DISTURBANCE ($ THOUSANDS) = 18919.390

EFFECTS PER $1 MILL. OF INITIAL DISTURBANCE
EMPLOYMENT = 12.4(JOBS)
INCOME = $ 184393.20
STATE TAXES = $ 11468.53
LOCAL TAXES = $ 17322.55
VALUE ADDED = $ 333072.80

Source: Regional Science Research Institute, User's Handbookfor PC I-O: A Regional Input-Output Model, Peace Dale, Rhode Island, 1987, Appendix C.

4.0 THE ECONOMIC IMPACT OF THE BAYOU LA BATRE PROJECT

4.1 Introduction

The Mobile District requires an economic impact model that will: 1) be available for use on a PC; 2) estimate economic impacts on a year-by-year basis; and 3) estimate additional tax revenues which could be used to reimburse state and local governments for the local share of project costs. None of the Department of Defense-developed models reviewed in Section 3 meet all of these requirements; private models could possibly be tailored to meet the requirements, but only at significant additional cost to the Mobile District. Thus STRATEGICA has developed an easy-to-use, PC-based model to estimate the economic impacts of the Bayou La Batre harbor and channel deepening project.

The STRATEGICA model begins with user-supplied data on the direct effects of the project: the increases in regional output, employment, and income resulting directly from the existence of the project. Thus the first part of this section discusses the estimation of the direct economic effects of the Bayou La Batre project, and the second part discusses the STRATEGICA model and estimates the total economic impact of the project. Appendix A provides the detailed specifications for the STRATEGICA model and instructions for its application.

4.2 Direct Effects of the Project

The proposed harbor deepening project will increase the present 12-foot channel to either 14, 16, 18, 20, or 22 feet (Mobile District, 1987). The national economic development benefits of the project take the form of cost savings to the major industries in Batou La Batre: commercial fishing and shipbuilding. These benefits are estimated to average $4,885,100 per year (discounted annual average) for an 18-foot channel (1). Cost savings would be smaller for lesser depths.

Cost savings in commercial fishing would occur because the deeper channel would reduce vessel delays, vessel damages, diver costs, and travel time. Cost savings in shipbuilding and repair would be realized from reduced vessel delays in sea trials and deliveries, the increased ability to repair ships in Bayou La Batre rather than at sea, the increased ability to conduct vessel testing at Bayou La Batre rather than elsewhere, and reduced vessel damages.

The Mobile District (1) estimates that the growth in output of each industry will be the same under with project conditions as under without project conditions, but that the output will be produced at lower cost (i.e., using less labor and materials). While these cost savings will increase the efficiency of the commercial fishing and shipbuilding industries (and hence create national economic development benefits), they will reduce employment and income in Bayou La Batre.

At this level of analysis, then, it appears that the Bayou La Batre region will benefit from the construction impact of the harbor deepening project, but suffer localized impacts from operation of the project. Nevertheless, STRATEGICA believes that deepening the harbor and channel at Bayou La Batre will lead to a significant expansion of employment, income and output in the shipbuilding and repair industry.

Interviews with a number of the sixteen local shipbuilders determined that the Bayou La Batre shipbuilding and repair industry has a significant competitive advantage compared to other producers. The competitive advantage stems from 1) the long experience of the Bayou La Batre firms (many of which have been in the same families for four generations); 2) the fact that several of the larger shipbuilders also own and operate fishing fleets, which keeps them current with technological developments in ship design; and 3) low labor costs stemming from the fact that Bayou La Batre shipbuilders employ nonunion labor.

The trend in fishing trawlers is toward larger vessels. Size is also important in other kinds of ships produced at Bayou La Batre: research vessels, coast guard vessels, and military landing craft. Servicing research vessels and oil drilling platforms is also hampered by the shallow channel; so is repair work on larger vessels such as oil tankers. Bayou La Batre shipbuilders report that they have lost construction and repair contracts due to the limitations associated with the 12-foot channel.

The Bayou La Batre shipbuilding industry currently constructs an average of 115 vessels per year and repairs an additional 725 vessels. Employment ranges between 700 and 1000 workers over a typical year (1). This volume of business is well below peaks reached in the late 1970's (6). Part of the decline is due to the national economic recessions of 1980 and 1981-82, and part to the increase in the exchange rate of the dollar in 1980-85 (which gave foreign shipbuilders a cost advantage). Nevertheless, a large share of the decline in Bayou La Batre's production is due to the constraints imposed by the 12-foot channel. Shipbuilders estimate that business would double within a year or two of completion of an 18-foot channel The shipbuilders believe that a 20-foot channel would create even more business opportunities.

The additional production, employment, and income made possible by deepening the Bayou La Batre harbor to 18 feet would create <u>regional development benefits</u> for the Bayou La Batre region. That is, Bayou La Batre shipbuilders would increase their share of the national market. Additional development benefits would be created too, as the lower costs at Bayou La Batre are translated into lower prices for a larger number of customers. Moreover, additional foreign business (which would otherwise go to producers in other countries) might well be

attracted to Bayou La Batre. Bayou La Batre shipbuilders already do a considerable volume of export business, mostly with customers in Latin American and African countries.

There are also potential development benefits from commercial fishing and simulated seafood (surimi) production in the Bayou La Batre region. The traditional emphasis of commercial fishing and seafood processing has been shrimp, however, and shrimp production will be constrained by biomass limitations after the year 2000 (1). Fishing for and processing of butterfish (a Japanese delicacy), and other species used in surimi has the potential for rapid growth. But deepening the harbor is unlikely to increase the volume of seafood processed at Bayou La Batre. What is most likely is that a greater portion of the seafood processed will be landed at Bayou La Batre rather than trucked from other ports. Thus no regional development benefits were estimated for commercial fishing or seafood processing.

Regional development benefits of the Bayou La Batre harbor deepening project, then, were estimated for the construction of the project and for the resulting expansion of the shipbuilding and repair industry. The additional direct expenditures created by the change in final demand are expected to have a multiplier effect on the region -- in terms of jobs, earnings, and state and local government tax revenue.

4.2.1 The Direct Effects of Project Construction

Table 4-1 reports the estimated construction expenditures for the harbor and channel deepening project. Costs are estimated by type for each of several alternative channel depths.

It is clear from the data in Table 4-1 that construction of the project is not labor-intensive. At the recommended 18-foot depth, labor costs account for only 11 percent of the $13.1 million total cost. Materials purchases for bulkheads, on the other hand, represent 63 percent of the costs of the project.

In 1986, the average construction worker earned $25,225, including employer-paid benefits, or burden (35). Thus the labor expenditures for the 18-foot channel of $1,436,400 would create 28.45 direct jobs in construction for each of the two years required for construction of the project.

4.2.2 Direct Impact on the Shipbuilding Industry

Table 4-2 estimates the direct impact on the shipbuilding industry in terms of employment for each year of the 50-year life of the project. The first column reports the Corps of Engineers without project employment estimates (1). Column two reports the losses of jobs implied by the project improvements to commercial fishing (i.e., fewer commercial fishing vessel repairs). The third column reports the losses of jobs implied by project improvements to the shipbuilding and repair industry

Table 4-1
Preliminary Cost Estimates, Bayou La Batre Project
(thousands of dollars)

Channel Depth:	14'	16'	18'	20'	22'
Dredging:					
Labor	$ 763.9	$ 974.0	$1,236.4	$1,771.1	$2,123.5
Fuel	307.7	389.6	494.5	708.4	849.4
Food & Water	128.2	162.1	206.1	295.2	353.9
Other (disposal lands, the dredge, etc.)	1,809.2	2,170.8	2,634.2	3,578.8	4,201.4
Subtotal	3,014.4	3,696.7	4,571.2	6,353.5	7,528.2
Bulkheads:					
Labor	200.0	200.0	200.0	200.0	200.0
Fuel	20.0	20.0	20.0	20.0	20.0
Materials and Other	5,716.8	7,492.8	8,315.8	10,272.8	13,300.8
Subtotal	5,936.8	7,712.8	8,535.8	10,492.8	13,520.8
TOTAL COSTS	$8,951.2	$11,409.5	$13,107.0	$16,846.4	$21,049.0
Construction Period (months)	24	24	24	24	24

Source: U.S. Army Corps of Engineers, Mobile District.

The fourth column is STRATEGICA's projection of total employment under with project conditions (net of all losses due to project benefits). The projection is based upon the reported expectations of Bayou La Batre Shipbuilders. It provides for the doubling of 1986 employment by the sixth year of project life (1996), with growth thereafter at the rate projected by the Corps of Engineers (1.4 percent per year, see (1)). Figure 4-1 illustrates employment growth [illegible] pbuilding under without and with project conditions.

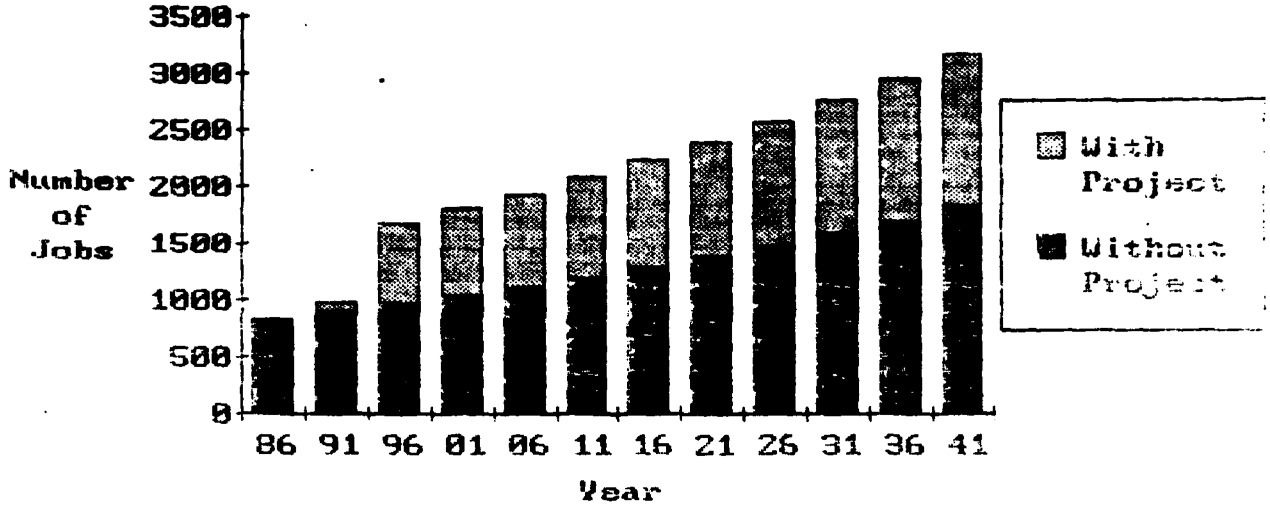
1.2.3 Direct Impact on Commercial Fishing

Due to the benefits of the proposed project (principally time saved by commercial fishing vessels), employment in commercial fishing will be reduced under with project conditions. The reduction is estimated at 7 jobs in 1991, which will grow to 8 jobs in 2001 and remain constant thereafter.

Table 4-2
Impact on Direct Employment
in the Shipbuilding and Repair Industry (SIC 373)
of the Bayou La Batre Harbor-Deepening Project

Year	Corps Without Project Estimates (# of Jobs)	Losses due to Channel Improvements: Commercial Fishing Repairs (# of Jobs)	Losses due to Channel Improvements: Ship-Building (# of Jobs)	STRATEGICA With Project Estimates (# of Jobs)	Net Gain or Loss (# of Jobs)
1986	850	---	---	850	---
1987	862	---	---	862	---
1988	874	---	---	874	---
1989	886	---	---	886	---
1990	899	---	---	899	---
1991	911	-7	-52	999	88
1992	924	-7	-53	1,111	187
1993	937	-7	-53	1,236	299
1994	950	-7	-54	1,374	424
1995	963	-8	-55	1,528	565
1996	977	-8	-56	1,699	722
1997	990	-8	-57	1,723	733
1998	1,004	-8	-57	1,747	743
1999	1,018	-8	-58	1,772	753
2000	1,033	-8	-59	1,796	764
2001	1,047	-8	-60	1,822	774
2002	1,062	-8	-61	1,847	785
2003	1,077	-8	-61	1,873	796
2004	1,092	-8	-62	1,899	807
2005	1,107	-8	-63	1,926	819
2006	1,122	-8	-64	1,953	830
2007	1,138	-8	-65	1,980	842
2008	1,154	-8	-66	2,008	854
2009	1,170	-8	-67	2,036	866
2010	1,187	-8	-68	2,064	878
2011	1,203	-8	-69	2,093	890
2012	1,220	-8	-70	2,123	902
2013	1,237	-8	-71	2,152	915
2014	1,255	-8	-72	2,182	928

Figure 4-1
Bayou la Batre Employment
in Shipbuilding and Repair



Source: Without project estimates by U.S. Army Corps of Engineers, Mobile District,(1); with project estimates by STRATEGICA, Inc.

4.3 The STRATEGICA Economic Impact Model

The strategica regional economic impact model applies employment multipliers to direct construction and shipbuilding expenditures to estimate the total change in regional employment. Earnings-per-job estimates (including burden) are used to estimate the total impact on regional earnings. Then, effective tax rates are applied to estimate increases in revenue from major taxes. The first step, though, was to determine the appropriate region where the economic impact would occur.

4.3.1 Defining the Relevant Region

Increased income and employment which are the direct effects of the deeper harbor and channel will be created at Bayou La Batre. Since many of the workers in Bayou La Batre live elsewhere in Mobile County, and in adjoining Alabama and Mississippi counties, additional income will be produced throughout Mobile and contiguous counties. Respending of the direct income will create indirect employment and income in other parts of Alabama, and even in Mississippi.

In a local cost-recovery study, the region of interest depends upon the governments likely to provide the non-federal share of project costs. In the case of the Bayou La Batre project, the most likely governmental entity to provide the non-federal share is the State of Alabama (see Section 5). Therefore the STRATEGICA model was designed primarily to measure the economic impact of the project on the State of Alabama, and to estimate the enhanced tax revenues that should enable the State to recover its costs.

It is possible that the Mobile County will share in the costs of the Bayou La Batre project. An economic impact model was also developed for Mobile County, which included the impact on Mobile County property tax revenue.

It is likely that the City of Bayou La Batre will provide some "in kind" local cost sharing in the form of lands, easements, and rights-of-way (see Section 5). The City is expected to recover its costs via higher local tax revenues. But the City is constrained by its boundaries: the amount of recovery depends upon such factors as annexation and in-migration of population -- factors which cannot be accurately modeled. Moreover, comprehensive economic data are not reported for cities. For these reasons, an economic impact model was not developed for the City of Bayou La Batre.

4.3.2 Structure of the Model

The model begins with user-supplied estimates of construction employment, direct employment losses due to project improvements, and direct employment gains due to regional economic expansion. Construction employment is then translated into construction earnings, and net direct employment increases in shipbuilding and repair are translated into earnings and output, based upon data in the Census of Manufacturing (36). Then adjusted RIMS II multipliers are applied to the direct employment and earnings estimates to produce estimates of total employment and earnings attributable to the project for each year of project life. Finally, effective tax rates are applied for state sales and income taxes (for the Alabama region), and county property taxes (for the Mobile County region) to estimate increases in local tax revenues. (Detailed equations for each of these procedures are provided in Appendix A.)

4.4 The Regional Economic Impact of the Project

Figure 4-2 reports the estimated direct and indirect impacts of the Bayou La Batre project on the State of Alabama for employment, earnings and state tax revenues. The total employment impact grows from 57 jobs in 1989 to 2,836 jobs in the year 2041. The earnings impact, in 1986 dollars, is $1.3 million in 1989, and grows to $54.4 million by the year 2041.

Net additional tax receipts begin at $56,100 in 1989, and increase to $2.4 million by the year 2041. The annual average increment to state tax revenue is $1,592,400.

The estimated impact of the Bayou La Batre project on the Mobile County Economy is illustrated in Figure 4-3. The total number of jobs to be created in Mobile County increase from 43 in 1989 to 2,041 in the year 2041. Total additional earnings rise from $1.0 million in 1989 to $38.4 million in the year 2041. The net increase in County property tax revenue is estimated to grow from $5,500 in 1989 to $211,800 in the year 2041; the annual average is $140,900.

Figure 4-2
Impact of the Bayou La Batre Project
on the Alabama Economy
a) Employment

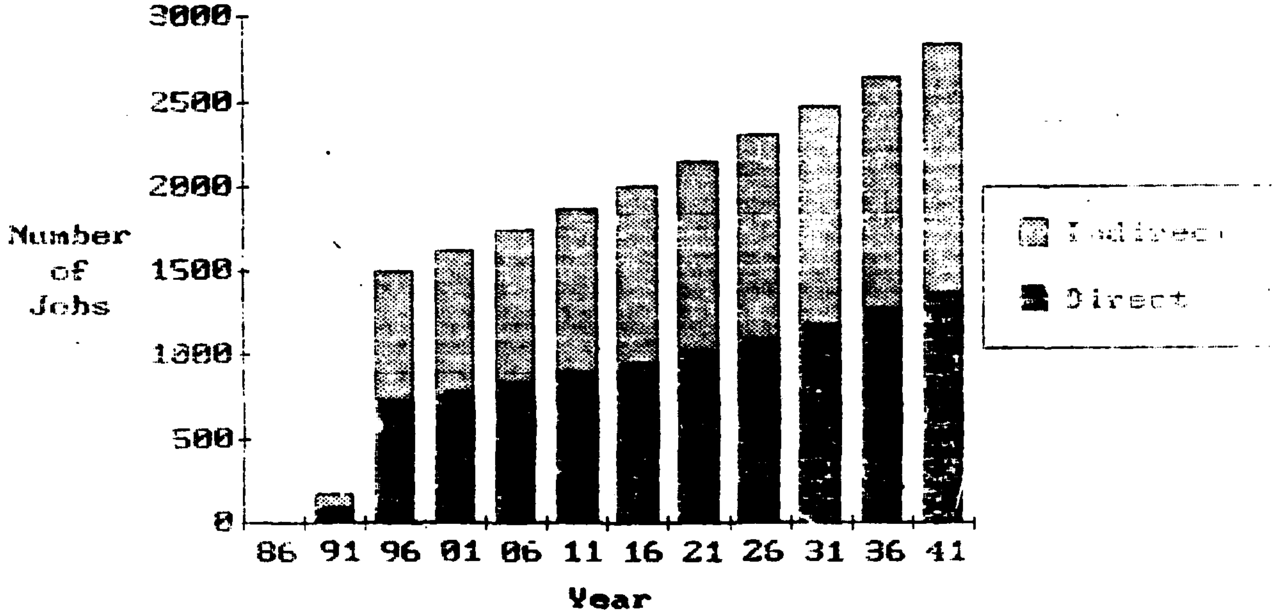
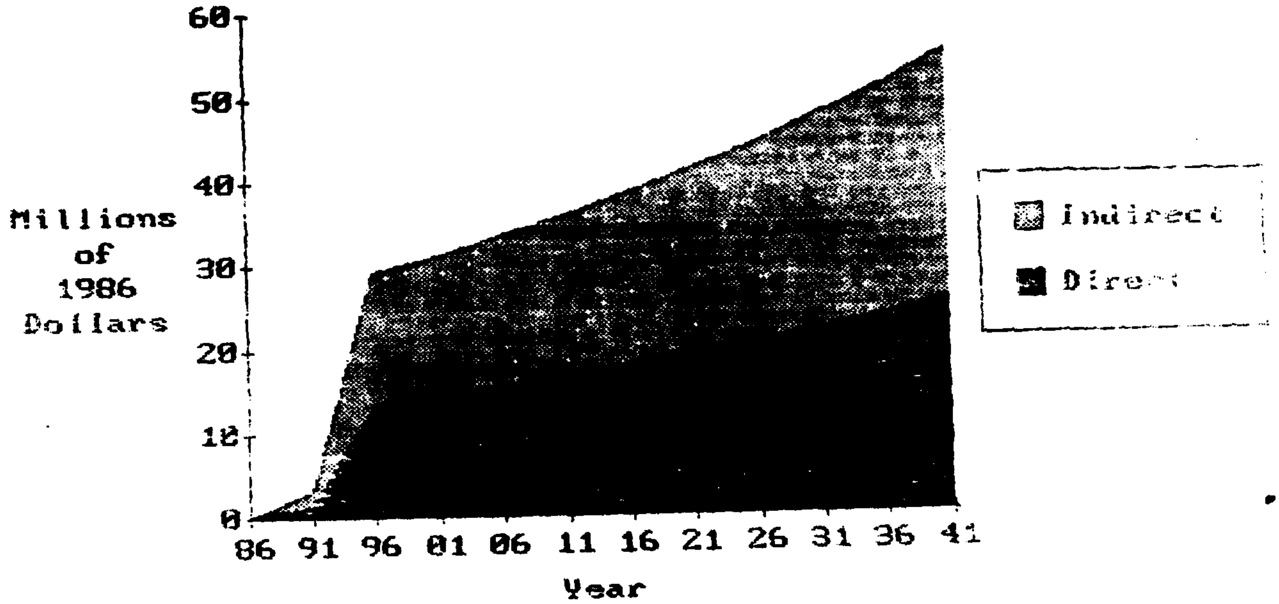
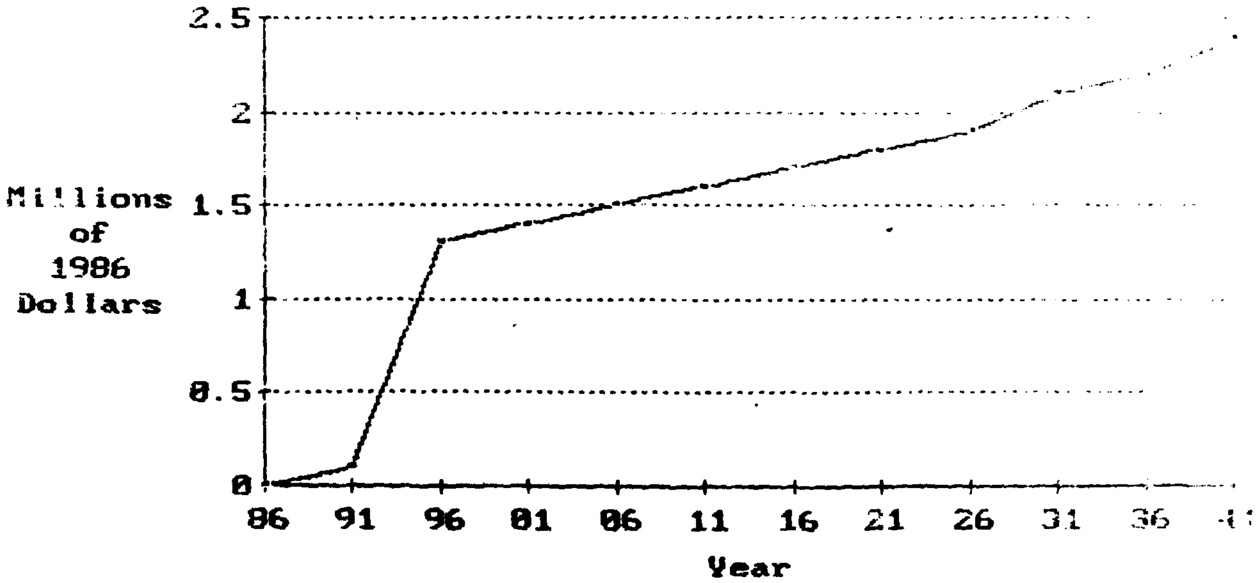


Figure 4-2 (Continued)
Impact of the Bayou La Batre Project on the Alabama Economy

b) Earnings



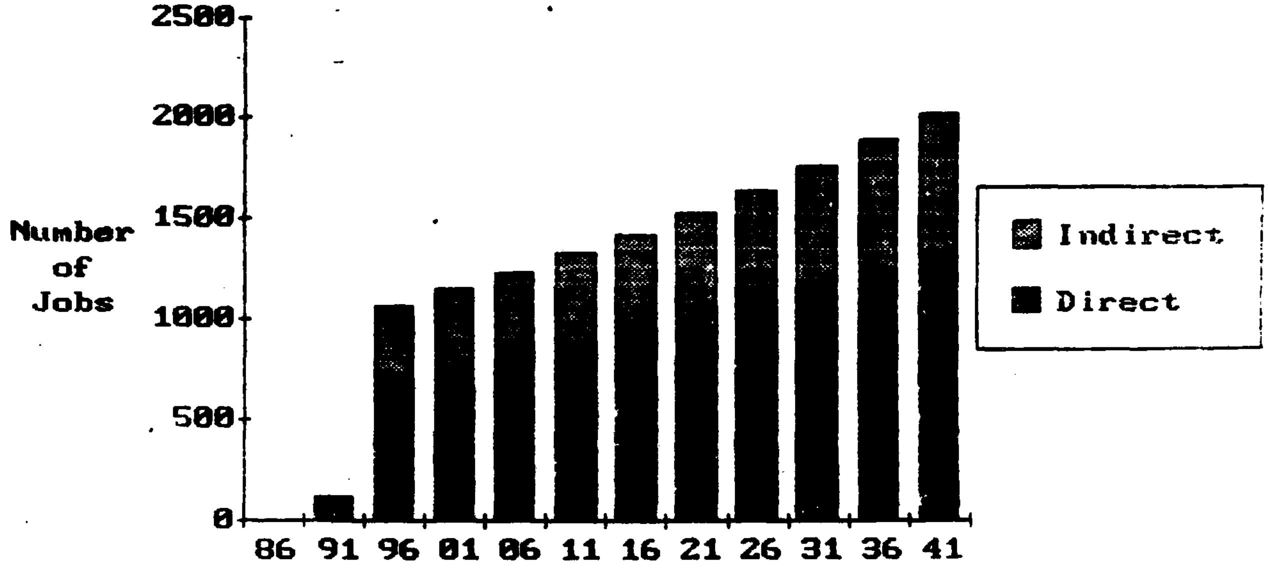
c) Increments to State Tax Revenue



Source: STRATEGICA, Inc.

Figure 4-3
Impact of the Bayou La Batre Project on the Mobile County Economy

a) Employment



b) Earnings

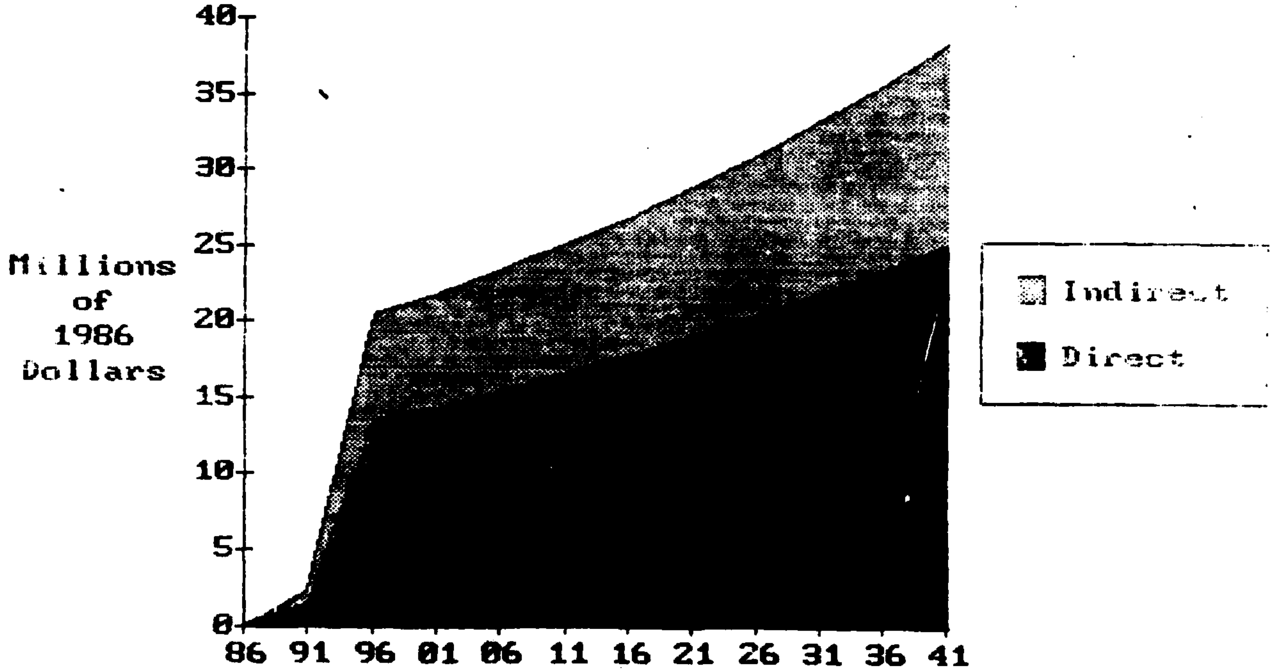
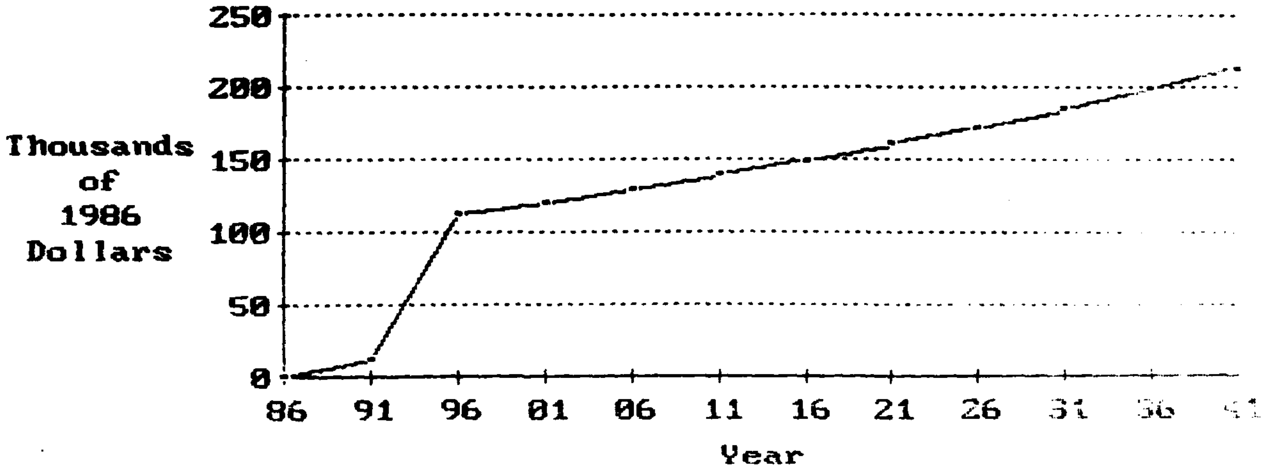


Figure 4-3 (Continued)
Impact of the Bayou La Batre Project
on the Mobile County Economy
c) Increments to Property Tax Revenue



Source: STRATEGICA, Inc.

The data upon which Figures 4-1, 4-2, and 4-3 are based are reported in Tables A-1 and A-2 in the Appendix to this report. STRATEGICA believes that the estimates of the direct impacts of the Bayou La Batre project are reasonable, and the adjusted RIMS II multipliers used to estimate the secondary effects are conservative. Nevertheless, simulations were prepared to determine the effects on state and local government tax revenue of smaller-than-anticipated project impacts.

4.5 Simulations

The estimates of the net increases in direct employment in shipbuilding and repair (see Table 4-2) were based upon the opinions of shipbuilders in the region. Simulations were prepared for two alternative cases. The first case assumes that only one-half of the additional jobs estimated in Table 4-2 result from the project. The second case assumes that only one-fourth of the additional jobs are produced.

The effects of these alternatives on increments to Alabama tax revenues for selected years are compared to the STRATEGICA estimates in Table 4-3. If only half of thr additional jobs in shipbuilding and repair are created by the project, the additional state tax revenues produced during the operational phase of the project grow from $60,300 in 1991 to $1,185,100 in the year 2041. Average additional revenues are $786,800, or 49.4

Table 4-3
Simulations of Additional Alabama Tax Revenues
Under Alternative Job-Creation Assumptions
(thousands of 1986 dollars)

Year	STRATEGICA Estimates	Case 1 1/2 of Direct Employment	Case 2 1/4 of Direct Employment
1989*	56.1	56.1	56.1
1990*	56.1	56.1	56.1
1991	138.9	60.3	21.0
1992	315.5	148.4	65.3
1993	515.5	248.1	115.0
1994	738.4	359.5	170.0
1995	990.0	485.1	233.1
1996	1,270.2	625.0	302.4
1997	1,289.5	634.5	307.4
1998	1,307.4	643.0	311.5
1999	1,324.4	651.5	319.6
2000	1,343.7	661.0	323.7
2001	1,361.1	669.5	329.0
.	.	.	.
.	.	.	.
.	.	.	.
2041	2,392.4	1,185.1	581.9
TOTALS	84,397	41,700	20,363
Average	1,592.4	786.8	384.2

* Construction phase; impacts are identical for all cases.
Source: STRATEGICA, Inc.

percent of the average revenues estimated by STRATEGICA. If only 1/4 of the estimated additional direct jobs are created by the project, the additional state tax revenue generated during the operational phase will rise from $21,000 in 1991 to $581,900 in the year 2041, for an annual average of $384,200.

Table 4-4 reports the results of an identical simulation for the Mobile County model. [illegible]y 1/2 of the expected additional direct jobs in shipbuilding and repair are produced by the project, the annual increment to Mobile County property tax revenue during the operational phase of the project will grow from $5,100 in 1991 to $104,800 in the year 2041, for an annual average of $69,500. This represents 49.3 percent of the STRATEGICA estimate. If only 1/4 of the direct jobs are created, the annual increment to property tax revenue will rise from $1,600 in 1991 to $51,300 in the year 2041. The annual average would be $33,800, or 24.0 percent of the STRATEGICA estimate.

Table 4-4
Simulations of Additional Mobile County Property Tax Revenues
Under Alternative Job-Creation Assumptions
(thousands of 1986 dollars)

Year	STRATEGICA Estimates	Case 1 1/2 of Direct Employment	Case 2 1/4 of Direct Employment
1989*	5.5	5.5	5.5
1990*	5.5	5.5	5.5
1991	12.1	5.1	1.6
1992	27.7	12.9	5.6
1993	45.4	21.8	10.0
1994	65.2	31.6	14.8
1995	87.5	42.8	20.4
1996	112.3	55.2	26.6
1997	114.0	56.0	27.0
1998	115.6	56.7	27.4
1999	117.1	57.5	27.7
2000	118.8	58.3	28.1
2001	120.4	59.1	28.4
.	.	.	.
.	.	.	.
.	.	.	.
2041	211.8	104.8	51.3
TOTALS	7,468	3,684	1,792
Averages	140.9	69.5	33.8

* Construction phase; impacts are identical under all cases.
Source: STRATEGICA, Inc.

4.6 Conclusions

The STRATEGICA regional economic impact model is a PC-based, easy-to-use model developed for application to the Bayou La Batre harbor deepening project. The instructions provided in the Appendix allow the user of the model to simulate a variety of project impacts, and to test the sensitivity of the various parameters. For example, the user can change the direct employment impacts, change the earnings-per-worker estimates, substitute multipliers from other sources, and alter the effective local tax rates. The model can also be applied to different kinds of projects and other regions. Two important limitations should be noted, however.

First, the user of the STRATEGICA model must supply the direct project impacts for each year. This same restriction applies to all regional economic impact models, but it is nevertheless important to bear in mind.

Second, regional economies, like national economies, change over time. Technological developments alter the technical coefficients in the underlying input-output model (or the structural equations in the underlying econometric model). Moreover, the growth of regional industries, and the entry of new industries into the region, change the distribution of input purchases. In addition, productivity improvements change labor requirements and real earnings. For these reasons, the estimated regional impacts generated by any model are less certain for distant-future years than for near-future years. While it is necessary to estimate economic impacts for each year of the 50-year life of a water resources project, little confidence can be placed in the estimates for years in the next century.

With these limitations in mind, it is nevertheless concluded that the Bayou La Batre harbor deepening project will produce significant numbers of jobs in Mobile County and the State of Alabama, substantial contributions to regional earnngs, and important increments to state and local government tax receipts.

5.0 COST RECOVERY ANALYSIS

5.1 Non-Federal Share

As stated in the Introduction, the Water Resources Development Act of 1986 requires that non-Federal sponsors provide 10 percent of the general navigation cost during the construction period, and another 10 percent of the cost over the subsequent 30 years for harbor depths of 20 feet or less. The non-Federal sponsors, however, must provide disposal lands, easements, and rights-of-way, the value of which is to be credited against the second 10 percent.

The Mobile District Office has developed project cost estimates for deepening the Bayou La Batre harbor and channel in two-foot increments from 14' to 22', as shown in Table 4-1.

For a channel deepening of 18', for example, the total project cost is estimated to be $13.1 million. According to the Mobile District Office, the non-Federal interests will be required to pay $0.3 million of the general navigation costs plus the entire amounts for bulkhead improvements ($8.5 million) and for relocations ($1.6 million), for a total non-Federal share of $10.4 million. The mechanism through which these funds would be provided will depend upon the nature of the non-Federal sponsor(s).

5.2 Potential Non-Federal Sponsors

The potential non-Federal sponsors are: the State of Alabama; the County of Mobile, which contains Bayou La Batre; the City of Bayou La Batre; or private sector firms operating in Bayou La Batre providing funds through one of the governmental entities.

The State of Alabama would benefit from the planned Bayou La Batre project through increased economic activities that would produce increases in tax revenues. The principal tax sources would be State income taxes paid by individuals and corporations and the State portion of the sales tax (4 percent). The State already has established means for financing harbor projects through the Alabama State Docks, as discussed below. The project would enable the State to play an even larger role in export markets, particularly for vessels of all types and for processed fish and seafood. The State of Alabama would undoubtedly be the largest non-Federal beneficiary.

The County of Mobile would benefit from the planned project mainly through increases in property taxes. Because property tax rates in Alabama are relatively low, the County is not likely to receive significant additional revenues from the project. Fur-

thermore, the City of Mobile is the dominant entity in the County, and it seems unlikely that the County government would earmark funds for a project in Bayou La Batre.

The City of Bayou La Batre would benefit through an increase in sales tax collections (2 percent of the 6 percent collected by the State), and through increases in beverage, gasoline, and property tax collections. For the City's Fiscal Year 1987, the budget was $1.168 million. According to Mayor J.F. "Jiggs" Nelson, the City would be unable to finance the non-Federal share without a significant tax increase. The City Council could vote to increase the City's portion of the sales tax to, say, 3 percent (as has occurred in the City of Mobile), which would generate about $200,000 in new tax revenues annually. Although the City would benefit from the project, there would be a considerable "leakage" of benefits to Mobile County and to the State of Alabama.

Certain private firms operating in Bayou La Batre would benefit through increased business activities. These firms are primarily engaged in shipbuilding and repair, in seafood and fish processing, and in fishing. A precedent for private financing of a governmental project was set recently when local seafood processors pledged the funds to construct a wastewater disposal line to carry effluent from these plants to Mississippi Sound. In the case of the planned harbor deepening project, however, the benefits are likely to be distributed more broadly, and it would seem preferable for governmental interests to provide the non-Federal share.

In view of the substantial benefits forecast for the State of Alabama, it is apparent that the most likely source of the non-Federal share is the State. The State could issue revenue bonds in the amount required for the non-Federal share or could use funds available through the Alabama Heritage Fund.

The purposes of the Alabama Heritage Fund Act (H. 71, November 30, 1981) include "the improvement of navigation in Mobile Harbor and on navigable inland waterways". The Heritage Fund was established using proceeds from oil and gas leases and from a $520 million State general obligation bond issue.

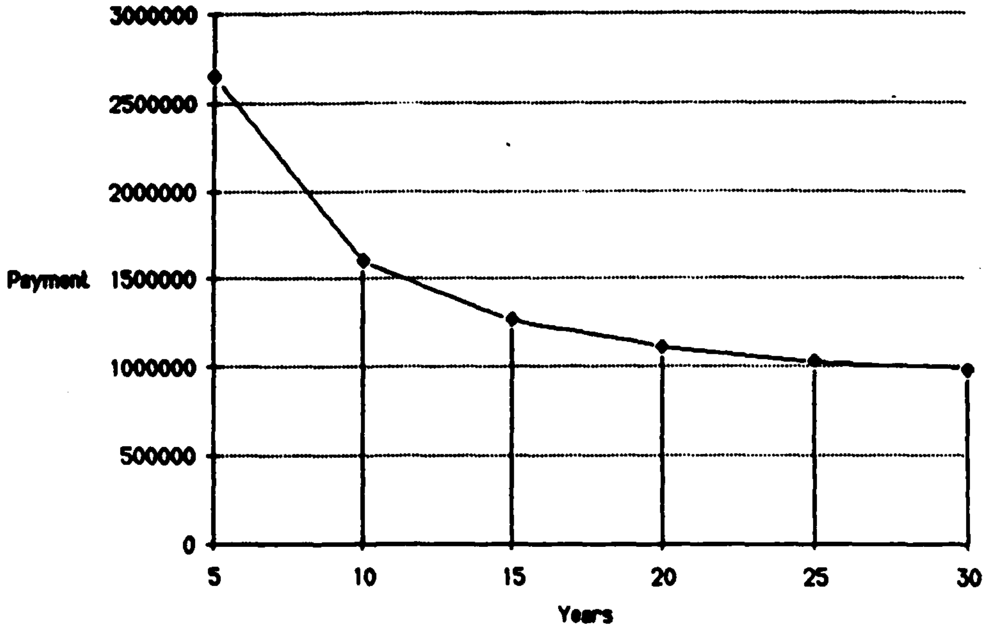
5.3 Financing Plan

The projections of future benefits expected from the deepening of the Bayou La Batre harbor and channel indicate that the State of Alabama would be the principal beneficiary among the several non-Federal interests. The State could allocate funds from the Heritage Trust Fund to cover the required $10.4 million share (for an 18' channel). Alternatively, the State of Alabama could issue revenue bonds for the total amount and amortize the payments over 10-30 years.

If the State should elect to issue revenue bonds, the following table and chart indicate how the annual payments for refunding the bonded indebtedness would vary according to the payback period. These calculations were based on an assumed $10.4 million issue using the present U.S. government interest rate of 8.625 percent per annum.

ANNUAL PAYMENTS TO AMORTIZE $10.4 MILLION REVENUE BONDS
8.625 PERCENT/ANNUM INTEREST

No. Years	Annual Payments
5	$2,647,800
10	1,593,880
15	1,261,780
20	1,109,000
25	1,026,790
30	978,810



From the table and chart above, it is apparent that extending the amortization period beyond 30 years does not cause the annual payments to be significantly lower. Payments for periods beyond 30 years approach the minimum payment of $897,000 asymptotically.

5.4 Analysis

The expected increases in Alabama state tax revenues would be less than the amounts needed to meet the revenue bond payments during the project's early years, but would rise above amounts needed to amortize a $10.4 million revenue bond over 20 years by the year 1996. As indicated in Table A-1, the projected State tax increase would be $315,000 for the year 1992, and would increase to $1.270 million per year by the year 1996.

If revenue bonds were to be issued by the State, the State's share might be less than indicated for two reasons: the preliminary cost estimates made by the Corps of Engineers might be reduced through competitive bidding and alternative construction designs, particularly for the bulkhead improvements; and if the City of Bayou La Batre should grant easements, land for dredged spoil, and other "in-kind" contributions as part of the non-Federal share.

Furthermore, the benefits estimated are believed to be conservative, because there it was not possible to account for the "superhighway effect". That is, there is no way to estimate the impact of new types of businesses that might be established in the region following completion of the project. Such businesses might include a containerized freight handling facility, suppliers supporting oil and gas exploration and production, and firms provisioning and resupplying vessels.

In summary, the findings of this analysis indicate that the State of Alabama is likely to recover the entire non-Federal share of the planned harbor and channel deepening project at Bayou La Batre over the life of the project. The most likely source of the non-Federal funds appears to be the Alabama Heritage Fund. Alternatively, the State could issue 20- to 30-year revenue bonds with annual amortization payments to be made from expected increased State tax revenues.

APPENDIX A: MODEL SPECIFICATIONS

A.1 Model Specifications

A.1.1 Direct Employment and Earnings: Construction

Labor costs for 18-foot channel are estimated at $1,436,300, spread over two years (1). Construction industry earnings, including burden, in Alabama were $1,902 million in 1986 (35). Construction industry employment in Alabama was 75,400 in 1986 (38). Thus earnings per worker in 1986 were:

$1,902,000,000 / 75,400 = $25,225

Dividing the annual labor expenditure for the project by the annual earnings per job provides an estimate of the number of direct construction jobs in 1989 and 1990:

$1,436,300 / 2 / $25,225 = 28.47 jobs per year.

A.1.2 Direct Employment: Shipbuilding and Repair

A.1.2.1 Without Project Baseline Estimates

The Mobile District estimated that current employment in the Bayou La Batre shipbuilding and repair industry varies seasonally between 700 and 1,000 jobs; and that future employment growth will be 1.4 percent per year (1). STRATEGICA took the midpoint of the current range -- 850 -- and applied a 1.4 percent annual growth rate to derive the estimates shown in Table 4-2.

A.1.2.2 Losses Due to Project Improvements

Benefits to commercial fishing: Savings in vessel damages are estimated at $374,100 per year (1). The average hourly labor cost is estimated by the same source to be $10. The 1982 Census of Manufacturing (36) reports that a bit over 30 percent of the value of shipments in the shipbuilding and repair industry (SIC 373) is spent on payroll, and that the annual average hours worked per production worker were 1,893.6. Thus the damages were multiplied by 30 percent to estimate the labor costs saved, and divided by $10 per hour and 1,893.6 hours to estimate the number of jobs saved:

$374,100 x 0.30 / $10 / 1,893.6 = 5.93 jobs.

Savings in diver costs were estimated to be $46,200; divers were reported to earn $20 per hour (1). Assuming that divers work 1,900 hours per year, the number of diver jobs saved is:

$46,200 / $20 / 1,900 = 1.22 jobs.

Thus the total loss of jobs in the shipbuilding and repair industry due to project improvements to the commercial fishing industry is 5.93 + 1.22 = 7.15 jobs.

Benefits to shipbuilding and repair: Reductions in vessel damages in the shipbuilding and repair industry are estimated to be $312,700 per year; reduced delays are expected to save $198,500; and operational savings are estimated at $905,800 (1). The proportions of labor costs are estimated at 30 percent, 45 percent, and 83 percent, respectively. Using the $10 per hour Labor cost, and 1,893.6 hours per year, the jobs saved are estimated as follows:

Vessel Damages:	$312,700 x 0.30 / 10 / 1,893.6 =	4.95
Vessel Delays:	$198,500 x 0.45 / 10 / 1,893.6 =	4.72
Operations:	$905,800 x 0.83 / 10 / 1,893.6 =	39.70
Total Jobs Saved		49.37

The reduction in shipbuilding and repair employment from benefits to commercial fishing (7.15 jobs), and benefits to shipbuilding and repair (49.37) were increased by 1.4 percent per year (and rounded to the nearest whole job) to obtain the estimates shown in the second and third columns of Table 4-2.

A.1.2.3 With Project Estimates

Interviews with several major shipbuilders in Bayou La Batre determined that the industry expects business to double within one year after an 18-foot channel is opened (and triple if a 20-foot channel were constructed). The STRATEGICA project team took the more conservative view that removal of the 12-foot channel constraint would result in a doubling of employment in the sixth year of project operation, net of losses due to project benefits. After the sixth year, employment was estimated to grow at the rate projected by the Mobile District. This resulted in projected growth rates of 1.4 percent per year from 1986-90, 11.2 percent per year from 1990-96, and 1.4 percent per year thereafter. The with project estimates are shown in Tables A-1 and A-2, below.

The rapid growth in the industry upon opening of the 18-foot channel occurs because Bayou La Batre shipbuilders would become able to capture larger shares of the national (and international) markets for newly-constructed vessels and ship repairs. It is believed that Bayou La Batre shipbuilders would obtain this additional business at the expense of competitors in other states and foreign countries.

A.1.3 Direct Employment and Income: Commercial Fishing

The reduction in opportunity costs to labor in the commercial fishing industry due to the project are estimated at $175,400; the estimated hourly labor costs are $20.68 (1). Assuming that the

average worker in commercial fishing works 1,900 hours per year, the number of jobs saved is:

$175,400 / $20.68 / 1,900 = 4.46

In addition, the savings in running time via Petit Bois Pass is estimated to be 2,214 person-hours per year (1). Dividing by 1,900 hours yields an estimate of 1.17 additional jobs saved.

The total jobs lost in commercial fishing, (4.46 + 1.17 = 5.63) were projected to grow by 1.9 percent per year until 2001, and then remain constant. The growth rate was the rate used by the Mobile District (1). The resulting losses in commercial fishing employment are also shown in Tables A-1 and A-2.

Earnings (including burden) per direct job lost were estimated to be total labor costs saved divided by the number of jobs lost:

($175,429 + $45,785) / 5.63 = $39,292

A.1.4 Indirect Project Effects

The study team began with the idea of estimating economic base multipliers for Mobile County and for the State of Alabama in order to estimate the indirect effects of the Bayou La Batre project. Two approaches were taken. The first applied regression analysis to time series data on 2-digit SIC employment, which were allocated to basic and nonbasic categories using the location quotient technique (see Section 3) The purpose was to estimate nonbasic employment as a function of basic employment and time. The results were unsatisfactory: employment multipliers exceeded 4.5 for Alabama and 3.5 for Mobile County.

The second approach began with employment by 4-digit SIC industry from County Business Patterns (39, 40), and again used the location quotient technique to allocate employment in each industry into basic and nonbasic components. This is the method recommended by the developers of EIFS (12). Again though, the employment multipliers were unrealistically high.

It was then decided to use published output, earnings, and employment multipliers for the State of Alabama from the RIMS II system; and to adjust the multipliers downward for Mobile County. (The user of the STRATEGICA model can readily substitute other multipliers). The following paragraphs provide details of the STRATEGICA estimates.

A.1.4.1 Shipbuilding and Repair

RIMS II multipliers for transportation equipment, except motor vehicles, in the State of Alabama are as follows (28):

Output: $2.2128 of output is produced in all industries for each dollar of final demand in transportation equipment, except motor vehicles (TExMV).

Earnings: $0.6544 of earnings in all industries is produced for each dollar of final demand in TExMV.

Employment: 34.0 jobs are created in all industries for each $1 million of final demand in TExMV.

The estimates of the earnings ($10 per hour) and hours per year (1,893.6) used above were applied to estimate annual earnings per worker in the shipbuilding and repair industry: $18,936. Then the ratio of payroll to value of shipments from the Census of Manufacturing (0.3057) was applied to estimate output per job:

$18,936 / 0.3057 = $61,943

Each $1 million in output therefore produces:

1,000,000 / 61,943 = 16.1 direct jobs.

Since the RIMS II employment/output multiplier is 34.0, the indirect jobs produced by $1 million in output must be 34.0 - 16.1 = 17.9. The total number of jobs created by each direct job in shipbuilding and repair is thus:

34.0 / 16.1 = 2.1118

This employment multiplier was applied to the increase in direct employment in shipbuilding and repair (net of the small loss in commercial fishing employment) for each year of the project's life to estimate the increase in total Alabama employment. (The employment multiplier was reduced to 1.5 to estimate the increase in Mobile County employment.)

To obtain earning per indirect worker, the following calculation was made:

RIMS II earnings multiplier x $1 Million =	$654,400
Less direct earnings in Shipbuilding: $18,936 x 16.1 jobs	- 304,870
Equals total indirect earnings:	349,530
Divided by total indirect jobs (17.9) equals earnings per indirect worker:	$19,527

This estimate of earnings per indirect job was used for both the construction and operational phases of the project, and for both Alabama and Mobile County.

A.1.4.2 Construction

The RIMS II multipliers for the "new construction" industry were too high: construction of the Bayou La Batre project will be far less labor-intensive than the average construction project. It was decided to apply a statewide employment multiplier of 2.0 to the direct construction jobs (the Mobile County multiplier used was 1.5). Earnings per direct construction job were estimated above at $25,225.

A.1.5 Increases in Tax Revenue

Total personal income in Alabama in 1986 was $45,939 million (35). If transfer payments (which are not subject to the state income tax) of $7,987 million are subtracted, earned income was $37,952 million. Total receipts from the state income tax were $992.456 million (41). Thus the effective average income tax rate was:

$$\$992.456 / \$37,952 = 0.02615$$

Total state general sales tax receipts in 1986 were $818.427 million. Thus tax receipts per dollar of personal income were:

$$\$818.427 / \$45,939 = 0.01782$$

These rates were applied to the estimated total increase in regional income due to the project in each year of construction and operation of the project. The results were totaled to estimate the additional Alabama state government tax revenues produced by the Bayou La Batre project. The results are conservative since only the two largest taxes (which together account for 59 percent of state tax revenues) were included.

For Mobile County, the property tax is the major source of revenue, accounting for 69 percent of the County's own-source revenues (42). Increases in income are thought to increase property values, which in turn increase property tax revenues (20, p. 57). The ratio of Mobile County property tax receipts to total personal income in 1984 (the most recent year for which income data are available) is:

$$\$20,226,600^{*} / \$3,661,000,000^{**} = 0.00552$$

* ACIR (42)
** Bureau of Economic Analysis (43)

This ratio was applied to the projected increases in Mobile County Income to estimate the change in Mobile County tax receipts attributable to the project.

A.2 Model Results

The model results are discussed in Section 4. They are reported in detail in Table A-1 for Alabama, and Table A-2 for Mobile County. (The economic and tax impacts are illustrated in Figures 4-2 and 4-3, respectively.) The results indicate that the additional state tax receipts would likely be more than sufficient to recover the local share of the Bayou La Batre project cost. Additional County property tax revenue would recover the County's contribution of lands and easements (see Section 5).

Table A-1
Regional Economic Impact of Bayou La Batre Project
Region: Alabama

	1988	1989	1990	1991	1992
Direct Employment:					
Construction		29	29		
Shipbuilding, Repair				88	187
Commercial Fishing				-7	-7
TOTAL DIRECT EMPLOYMENT		29	29	81	180
Earnings/Worker ($1986):					
Construction		25,225	25,225		
Shipbuilding, Repair				18,936	18,936
Fishing				39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair		0.7	0.7	1.7	3.5
Fishing				-0.3	-0.3
TOTAL DIRECT EARNINGS		0.7	0.7	1.4	3.3
Employment Multiplier		2.0000	2.0000	2.1118	2.1118
Total Indirect Jobs		29	29	90	200
Earnings/Worker ($1986)		19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS		0.6	0.6	1.8	3.9
Earnings Multiplier		1.7741	1.7741	2.2607	2.1963
TOTAL EMPLOYMENT IMPACT		57	57	171	380
TOTAL EARNINGS IMPACT		1.3	1.3	3.2	7.2
State Sales Tax Revenue per $1 of Earnings		0.01782	0.01782	0.01782	0.01782
Increase in Sales Tax Revenue ($000 1986)		22.7	22.7	56.3	127.9
Effective State Income Tax Rate		0.02615	0.02615	0.02615	0.02615
Increase in Income Tax Revenue ($000 1986)		33.4	33.4	82.6	187.6
TOTAL INCREASE IN ALABAMA STATE REVENUES		56.1	56.1	138.9	315.5

Table A-1 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Alabama

	1993	1994	1995	1996	1997
Direct Employment:					
Construction					
Shipbuilding, Repair	299	424	565	722	733
Commercial Fishing	-7	-7	-7	-8	-8
TOTAL DIRECT EMPLOYMENT	292	417	558	714	725
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	5.7	8.0	10.7	13.7	13.9
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	5.4	7.7	10.4	13.4	13.6
Employment Multiplier	2.1118	2.1118	2.1118	2.1118	2.1118
Total Indirect Jobs	325	463	620	794	806
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	6.3	9.0	12.1	15.5	15.7
Earnings Multiplier	2.1773	2.1683	2.1630	2.1596	2.1597
TOTAL EMPLOYMENT IMPACT	616	880	1,178	1,509	1,532
TOTAL EARNINGS IMPACT	11.7	16.8	22.5	28.9	29.3
State Sales Tax Revenue per $1 of Earnings	0.01782	0.01782	0.01782	0.01782	0.01782
Increase in Sales Tax Revenue ($000 1986)	208.8	299.2	401.2	514.8	522.6
Effective State Income Tax Rate	0.02615	0.02615	0.02615	0.02615	0.02615
Increase in Income Tax Revenue ($000 1986)	306.5	439.1	588.8	755.4	766.9
TOTAL INCREASE IN ALABAMA STATE REVENUES	515.3	738.4	990.0	1,270.2	1,289.5

Table A-1 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Alabama

	1998	1999	2000	2001	2002
Direct Employment:					
Construction					
Shipbuilding, Repair	743	753	764	774	785
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	735	745	756	766	777
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	14.1	14.3	14.5	14.7	14.9
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	13.8	13.9	14.1	14.3	14.5
Employment Multiplier	2.1118	2.1118	2.1118	2.1118	2.1118
Total Indirect Jobs	817	828	840	851	864
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	16.0	16.2	16.4	16.6	16.9
Earnings Multiplier	2.1597	2.1598	2.1599	2.1600	2.1598
TOTAL EMPLOYMENT IMPACT	1,553	1,573	1,596	1,617	1,640
TOTAL EARNINGS IMPACT	29.7	30.1	30.6	31.0	31.4
State Sales Tax Revenue per $1 of Earnings	0.01782	0.01782	0.01782	0.01782	0.01782
Increase in Sales Tax Revenue ($000 1986)	529.7	536.8	544.6	551.6	559.6
Effective State Income Tax Rate	0.02615	0.02615	0.02615	0.02615	0.02615
Increase in Income Tax Revenue ($000 1986)	777.3	787.7	799.1	809.5	821.2
TOTAL INCREASE IN ALABAMA STATE REVENUES	1,307.0	1,324.4	1,343.7	1,361.1	1,380.8

Table A-1 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Alabama

	2003	2004	2005	2006	2007
Direct Employment:					
Construction					
Shipbuilding, Repair	796	807	819	830	842
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	788	799	811	822	834
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	15.1	15.3	15.5	15.7	15.9
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	14.7	15.0	15.2	15.4	15.6
Employment Multiplier	2.1118	2.1118	2.1118	2.1118	2.1118
Total Indirect Jobs	876	888	901	914	927
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	17.1	17.3	17.6	17.8	18.1
Earnings Multiplier	2.1596	2.1594	2.1592	2.1590	2.1588
TOTAL EMPLOYMENT IMPACT	1,664	1,687	1,712	1,735	1,761
TOTAL EARNINGS IMPACT	31.9	32.3	32.8	33.2	33.7
State Sales Tax Revenue per $1 of Earnings	0.01782	0.01782	0.01782	0.01782	0.01782
Increase in Sales Tax Revenue ($000 1986)	567.6	575.5	584.2	592.2	600.9
Effective State Income Tax Rate	0.02615	0.02615	0.02615	0.02615	0.02615
Increase in Income Tax Revenue ($000 1986)	832.9	844.6	857.3	869.0	881.8
TOTAL INCREASE IN ALABAMA STATE REVENUES	1,400.5	1,420.1	1,441.6	1,461.2	1,482.7

Table A-1 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Alabama

	2008	2009	2010	2011	2012
Direct Employment:					
Construction					
Shipbuilding, Repair	854	866	878	890	902
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	846	858	870	882	894
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	16.2	16.4	16.6	16.9	17.1
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	15.8	16.1	16.3	16.5	16.8
Employment Multiplier	2.1118	2.1118	2.1118	2.1118	2.1118
Total Indirect Jobs	940	954	967	980	994
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	18.4	18.6	18.9	19.1	19.4
Earnings Multiplier	2.1587	2.1585	2.1583	2.1582	2.1580
TOTAL EMPLOYMENT IMPACT	1,786	1,811	1,837	1,862	1,887
TOTAL EARNINGS IMPACT	34.2	34.7	35.2	35.7	36.2
State Sales Tax Revenue per $1 of Earnings	0.01782	0.01782	0.01782	0.01782	0.01782
Increase in Sales Tax Revenue ($000 1986)	609.6	618.3	627.0	635.7	644.3
Effective State Income Tax Rate	0.02615	0.02615	0.02615	0.02615	0.02615
Increase in Income Tax Revenue ($000 1986)	894.5	907.3	920.0	932.8	945.5
TOTAL INCREASE IN ALABAMA STATE REVENUES	1,504.1	1,525.6	1,547.0	1,568.4	1,589.9

Table A-1 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Alabama

	2013	2014	2015	2016	2017
Direct Employment:					
Construction					
Shipbuilding, Repair	915	928	941	954	967
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	907	920	933	946	959
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	17.3	17.6	17.8	18.1	18.3
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	17.0	17.2	17.5	17.7	18.0
Employment Multiplier	2.1118	2.1118	2.1118	2.1118	2.1118
Total Indirect Jobs	1,008	1,023	1,037	1,051	1,066
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	19.7	20.0	20.2	20.5	20.8
Earnings Multiplier	2.1578	2.1577	2.1575	2.1574	2.1572
TOTAL EMPLOYMENT IMPACT	1,915	1,942	1,970	1,997	2,025
TOTAL EARNINGS IMPACT	36.7	37.2	37.7	38.3	38.8
State Sales Tax Revenue per $1 of Earnings	0.01782	0.01782	0.01782	0.01782	0.01782
Increase in Sales Tax Revenue ($000 1986)	653.8	663.2	672.6	682.0	691.4
Effective State Income Tax Rate	0.02615	0.02615	0.02615	0.02615	0.02615
Increase in Income Tax Revenue ($000 1986)	959.4	973.2	987.0	1,000.8	1,014.6
TOTAL INCREASE IN ALABAMA STATE REVENUES	1,613.1	1,636.4	1,659.6	1,682.8	1,706.1

Table A-1 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Alabama

	2018	2019	2020	2021	2022
Direct Employment:					
Construction					
Shipbuilding, Repair	981	995	1,009	1,023	[illegible]
Commercial Fishing	-8	-8	-8	-8	[illegible]
TOTAL DIRECT EMPLOYMENT	973	987	1,001	1,015	1,029
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	18.6	18.8	19.1	19.4	19.6
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	18.3	18.5	18.8	19.0	19.3
Employment Multiplier	2.1118	2.1118	2.1118	2.1118	2.1118
Total Indirect Jobs	1,081	1,097	1,113	1,128	1,144
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	21.1	21.4	21.7	22.0	22.3
Earnings Multiplier	2.1571	2.1569	2.1568	2.1566	2.1565
TOTAL EMPLOYMENT IMPACT	2,054	2,084	2,113	2,143	2,172
TOTAL EARNINGS IMPACT	39.4	39.9	40.5	41.1	41.6
State Sales Tax Revenue per $1 of Earnings	0.01782	0.01782	0.01782	0.01782	0.01782
Increase in Sales Tax Revenue ($000 1986)	701.6	711.7	721.8	732.0	742.1
Effective State Income Tax Rate	0.02615	0.02615	0.02615	0.02615	0.02615
Increase in Income Tax Revenue ($000 1986)	1,029.5	1,044.4	1,059.3	1,074.2	1,089.0
TOTAL INCREASE IN ALABAMA STATE REVENUES	1,731.1	1,756.1	1,781.1	1,806.1	1,831.2

Table A-1 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Alabama

	2023	2024	2025	2026	2027
Direct Employment:					
Construction					
Shipbuilding, Repair	1,052	1,066	1,081	1,096	1,112
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	1,044	1,058	1,073	1,088	1,104
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	19.9	20.2	20.5	20.8	21.1
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	19.6	19.9	20.1	20.4	20.7
Employment Multiplier	2.1118	2.1118	2.1118	2.1118	2.1118
Total Indirect Jobs	1,160	1,176	1,193	1,209	1,227
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	22.7	23.0	23.3	23.6	24.0
Earnings Multiplier	2.1563	2.1562	2.1561	2.1559	2.1558
TOTAL EMPLOYMENT IMPACT	2,204	2,234	2,265	2,297	2,331
TOTAL EARNINGS IMPACT	42.3	42.8	43.4	44.0	44.7
State Sales Tax Revenue per $1 of Earnings	0.01782	0.01782	0.01782	0.01782	0.01782
Increase in Sales Tax Revenue ($000 1986)	753.0	763.1	774.0	784.9	796.5
Effective State Income Tax Rate	0.02615	0.02615	0.02615	0.02615	0.02615
Increase in Income Tax Revenue ($000 1986)	1,105.0	1,119.9	1,135.8	1,151.8	1,168.8
TOTAL INCREASE IN ALABAMA STATE REVENUES	1,858.0	1,883.0	1,909.8	1,936.6	1,965.2

Table A-1 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Alabama

	2028	2029	2030	2031	2032
Direct Employment:					
Construction					
Shipbuilding, Repair	1,127	1,143	1,159	1,175	1,192
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	1,119	1,135	1,151	1,167	1,184
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	21.3	21.6	21.9	22.2	22.6
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	21.0	21.3	21.6	21.9	22.2
Employment Multiplier	2.1118	2.1118	2.1118	2.1118	2.1118
Total Indirect Jobs	1,244	1,262	1,279	1,297	1,316
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	24.3	24.6	25.0	25.3	25.7
Earnings Multiplier	2.1557	2.1555	2.1554	2.1553	2.1552
TOTAL EMPLOYMENT IMPACT	2,363	2,396	2,430	2,464	2,500
TOTAL EARNINGS IMPACT	45.3	46.0	46.6	47.3	47.9
State Sales Tax Revenue per $1 of Earnings	0.01782	0.01782	0.01782	0.01782	0.01782
Increase in Sales Tax Revenue ($000 1986)	807.3	818.9	830.5	842.1	854.4
Effective State Income Tax Rate	0.02615	0.02615	0.02615	0.02615	0.02615
Increase in Income Tax Revenue ($000 1986)	1,184.7	1,201.7	1,218.7	1,235.7	1,253.8
TOTAL INCREASE IN ALABAMA STATE REVENUES	1,992.0	2,020.6	2,049.2	2,077.8	2,108.2

Table A-1 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Alabama

	2033	2034	2035	2036	2037
Direct Employment:					
Construction					
Shipbuilding, Repair	1,208	1,225	1,243	1,260	1,278
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	1,200	1,217	1,235	1,252	1,270
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	22.9	23.2	23.5	23.9	24.2
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	22.5	22.9	23.2	23.5	23.9
Employment Multiplier	2.1118	2.1118	2.1118	2.1118	2.1118
Total Indirect Jobs	1,334	1,353	1,373	1,392	1,412
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	26.0	26.4	26.8	27.2	27.6
Earnings Multiplier	2.1551	2.1549	2.1548	2.1547	2.1546
TOTAL EMPLOYMENT IMPACT	2,534	2,570	2,608	2,643	2,681
TOTAL EARNINGS IMPACT	48.6	49.3	50.0	50.7	51.4
State Sales Tax Revenue per $1 of Earnings	0.01782	0.01782	0.01782	0.01782	0.01782
Increase in Sales Tax Revenue ($000 1986)	866.0	878.3	891.3	903.7	916.7
Effective State Income Tax Rate	0.02615	0.02615	0.02615	0.02615	0.02615
Increase in Income Tax Revenue ($000 1986)	1,270.8	1,288.9	1,308.0	1,326.1	1,345.2
TOTAL INCREASE IN ALABAMA STATE REVENUES	2,136.8	2,167.2	2,199.3	2,229.7	2,261.9

Table A-1 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Alabama

	2038	2039	2040	2041	Average
Direct Employment:					
Construction					---
Shipbuilding, Repair	1,295	1,314	1,332	1,351	937
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	1,287	1,306	1,324	1,343	895
Earnings/Worker ($1986):					
Construction					25,225
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					---
Shipbuilding, Repair	24.5	24.9	25.2	25.6	17.8
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	24.2	24.6	24.9	25.3	16.8
Employment Multiplier	2.1118	2.1118	2.1118	2.1118	2.1076
Total Indirect Jobs	1,431	1,452	1,472	1,493	995
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	27.9	28.3	28.7	29.2	19.4235
Earnings Multiplier	2.1545	2.1544	2.1542	2.1541	2.1460
TOTAL EMPLOYMENT IMPACT	2,717	2,757	2,795	2,836	1,889
TOTAL EARNINGS IMPACT	52.1	52.9	53.6	54.4	36.2
State Sales Tax Revenue per $1 of Earnings	0.01782	0.01782	0.01782	0.01782	0.01782
Increase in Sales Tax Revenue ($000 1986)	929.0	942.8	955.8	969.6	645.4
Effective State Income Tax Rate	0.02615	0.02615	0.02615	0.02615	0.02615
Increase in Income Tax Revenue ($000 1986)	1,363.3	1,383.5	1,402.6	1,422.8	947.0
TOTAL INCREASE IN ALABAMA STATE REVENUES	2,292.3	2,326.2	2,358.4	2,392.4	1,592.4

Table A-2
Regional Economic Impact of Bayou La Batre Project
Region: Mobile County

	1988	1989	1990	1991	1992
Direct Employment:					
Construction		29	29		
Shipbuilding, Repair				88	187
Commercial Fishing				-7	-7
TOTAL DIRECT EMPLOYMENT		29	29	81	180
Earnings/Worker ($1986):					
Construction		25,225	25,225		
Shipbuilding, Repair				18,936	18,936
Commercial Fishing				39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair		0.7	0.7	1.7	3.5
Fishing				-0.3	-0.3
TOTAL DIRECT EARNINGS		0.7	0.7	1.4	3.3
Employment Multiplier		1.5000	1.5000	1.5000	1.5000
Total Indirect Jobs		14	14	41	90
Earnings/Worker ($1986)		19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS		0.3	0.3	0.8	1.8
Earnings Multiplier		1.3871	1.3871	1.5670	1.5380
TOTAL EMPLOYMENT IMPACT		43	43	122	270
TOTAL EARNINGS IMPACT		1.0	1.0	2.2	5.0
Mobile County Property Tax Revenue per $1 of Earnings		0.00552	0.00552	0.00552	0.00552
Increase in Property Tax Revenue ($000 1986)		5.5	5.5	12.1	27.7

Table A-2 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Mobile County

	1993	1994	1995	1996	1997
Direct Employment:					
Construction					
Shipbuilding, Repair	299	424	565	722	733
Commercial Fishing	-7	-7	-7	-8	-8
TOTAL DIRECT EMPLOYMENT	292	417	558	714	725
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Commercial Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	5.7	8.0	10.7	13.7	13.9
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	5.4	7.7	10.4	13.4	13.6
Employment Multiplier	1.5000	1.5000	1.5000	1.5000	1.5000
Total Indirect Jobs	146	208	279	357	363
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	2.8	4.1	5.4	7.0	7.1
Earnings Multiplier	1.5295	1.5254	1.5230	1.5215	1.5215
TOTAL EMPLOYMENT IMPACT	438	625	836	1,072	1,088
TOTAL EARNINGS IMPACT	8.2	11.8	15.9	20.4	20.7
Mobile County Property Tax Revenue per $1 of Earnings	0.00552	0.00552	0.00552	0.00552	0.00552
Increase in Property Tax Revenue ($000 1986)	45.4	65.2	87.5	112.3	114.0

Table A-2 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Mobile County

	1998	1999	2000	2001	2002
Direct Employment:					
Construction					
Shipbuilding, Repair	743	753	764	774	785
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	735	745	756	766	777
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Commercial Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	14.1	14.3	14.5	14.7	14.9
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	13.8	13.9	14.1	14.3	14.5
Employment Multiplier	1.5000	1.5000	1.5000	1.5000	1.5000
Total Indirect Jobs	368	373	378	383	388
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	7.2	7.3	7.4	7.5	7.6
Earnings Multiplier	1.5216	1.5216	1.5216	1.5217	1.5216
TOTAL EMPLOYMENT IMPACT	1,103	1,118	1,134	1,149	1,165
TOTAL EARNINGS IMPACT	20.9	21.2	21.5	21.8	22.1
Mobile County Property Tax Revenue per $1 of Earnings	0.00552	0.00552	0.00552	0.00552	0.00552
Increase in Property Tax Revenue ($000 1986)	115.6	117.1	118.8	120.4	122.1

Table A-2 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Mobile County

	2003	2004	2005	2006	2007
Direct Employment:					
Construction					
Shipbuilding, Repair	796	807	819	830	842
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	788	799	811	822	834
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Commercial Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	15.1	15.3	15.5	15.7	15.9
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	14.7	15.0	15.2	15.4	15.6
Employment Multiplier	1.5000	1.5000	1.5000	1.5000	1.5000
Total Indirect Jobs	394	399	405	411	417
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	7.7	7.8	7.9	8.0	8.1
Earnings Multiplier	1.5215	1.5214	1.5213	1.5212	1.5212
TOTAL EMPLOYMENT IMPACT	1,182	1,198	1,216	1,233	1,251
TOTAL EARNINGS IMPACT	22.4	22.8	23.1	23.4	23.8
Mobile County Property Tax Revenue per $1 of Earnings	0.00552	0.00552	0.00552	0.00552	0.00552
Increase in Property Tax Revenue ($000 1986)	123.9	125.6	127.5	129.3	131.2

Table A-2 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Mobile County

	2008	2009	2010	2011	2012
Direct Employment:					
Construction					
Shipbuilding, Repair	854	866	878	890	902
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	846	858	870	882	894
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Commercial Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	16.2	16.4	16.6	16.9	17.1
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	15.8	16.1	16.3	16.5	16.8
Employment Multiplier	1.5000	1.5000	1.5000	1.5000	1.5000
Total Indirect Jobs	423	429	435	441	447
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	8.3	8.4	8.5	8.6	8.7
Earnings Multiplier	1.5211	1.5210	1.5209	1.5209	1.5208
TOTAL EMPLOYMENT IMPACT	1,269	1,287	1,305	1,323	1,341
TOTAL EARNINGS IMPACT	24.1	24.4	24.8	25.1	25.5
Mobile County Property Tax Revenue per $1 of Earnings	0.00552	0.00552	0.00552	0.00552	0.00552
Increase in Property Tax Revenue ($000 1986)	133.1	135.0	136.9	138.8	140.7

AD-A201 866 FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT 3/6
FOR NAVIGATION IMPR..(U) CORPS OF ENGINEERS SOUTH
ATLANTIC MOBILE AL COASTAL SECTION.. J K GRAHAM ET AL.
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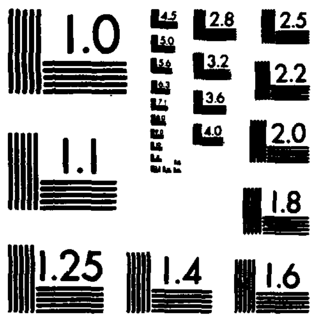

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Table A-2 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Mobile County

	2013	2014	2015	2016	2017
Direct Employment:					
Construction					
Shipbuilding, Repair	915	928	941	954	967
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	907	920	933	946	959
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Commercial Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	17.3	17.6	17.8	18.1	18.3
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	17.0	17.2	17.5	17.7	18.0
Employment Multiplier	1.5000	1.5000	1.5000	1.5000	1.5000
Total Indirect Jobs	453	460	466	473	479
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	8.9	9.0	9.1	9.2	9.4
Earnings Multiplier	1.5207	1.5206	1.5206	1.5205	1.5204
TOTAL EMPLOYMENT IMPACT	1,360	1,380	1,399	1,419	1,438
TOTAL EARNINGS IMPACT	25.9	26.2	26.6	27.0	27.3
Mobile County Property Tax Revenue per $1 of Earnings	0.00552	0.00552	0.00552	0.00552	0.00552
Increase in Property Tax Revenue ($000 1986)	142.7	144.8	146.8	148.9	151.0

Table A-2 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Mobile County

	2018	2019	2020	2021	2022
Direct Employment:					
Construction					
Shipbuilding, Repair	981	995	1,009	1,023	1,037
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	973	987	1,001	1,015	1,029
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Commercial Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	18.6	18.8	19.1	19.4	19.6
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	18.3	18.5	18.8	19.0	19.3
Employment Multiplier	1.5000	1.5000	1.5000	1.5000	1.5000
Total Indirect Jobs	486	493	500	507	514
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	9.5	9.6	9.8	9.9	10.0
Earnings Multiplier	1.5204	1.5203	1.5202	1.5202	1.5201
TOTAL EMPLOYMENT IMPACT	1,459	1,480	1,501	1,522	1,543
TOTAL EARNINGS IMPACT	27.7	28.2	28.6	29.0	29.4
Mobile County Property Tax Revenue per $1 of Earnings	0.00552	0.00552	0.00552	0.00552	0.00552
Increase in Property Tax Revenue ($000 1986)	153.2	155.4	157.6	159.8	162.0

Table A-2 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Mobile County

	2023	2024	2025	2026	2027
Direct Employment:					
Construction					
Shipbuilding, Repair	1,052	1,066	1,081	1,096	1,112
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	1,044	1,058	1,073	1,088	1,104
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Commercial Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	19.9	20.2	20.5	20.8	21.1
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	19.6	19.9	20.1	20.4	20.7
Employment Multiplier	1.5000	1.5000	1.5000	1.5000	1.5000
Total Indirect Jobs	522	529	536	544	552
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	10.2	10.3	10.5	10.6	10.8
Earnings Multiplier	1.5200	1.5200	1.5199	1.5199	1.5198
TOTAL EMPLOYMENT IMPACT	1,566	1,587	1,609	1,632	1,656
TOTAL EARNINGS IMPACT	29.8	30.2	30.6	31.0	31.5
Mobile County Property Tax Revenue per $1 of Earnings	0.00552	0.00552	0.00552	0.00552	0.00552
Increase in Property Tax Revenue ($000 1986)	164.4	166.6	169.0	171.4	173.9

Table A-2 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Mobile County

	2028	2029	2030	2031	2032
Direct Employment:					
Construction					
Shipbuilding, Repair	1,127	1,143	1,159	1,175	1,192
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	1,119	1,135	1,151	1,167	1,184
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Commercial Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	21.3	21.6	21.9	22.2	22.6
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	21.0	21.3	21.6	21.9	22.2
Employment Multiplier	1.5000	1.5000	1.5000	1.5000	1.5000
Total Indirect Jobs	559	567	575	583	592
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	10.9	11.1	11.2	11.4	11.6
Earnings Multiplier	1.5197	1.5197	1.5196	1.5196	1.5195
TOTAL EMPLOYMENT IMPACT	1,678	1,702	1,726	1,750	1,776
TOTAL EARNINGS IMPACT	31.9	32.4	32.9	33.3	33.8
Mobile County Property Tax Revenue per $1 of Earnings	0.00552	0.00552	0.00552	0.00552	0.00552
Increase in Property Tax Revenue ($000 1986)	176.3	178.8	181.4	183.9	186.6

Table A-2 (Continued)
Regional Economic Impact of Bayou La Batre Project
Region: Mobile County

	2033	2034	2035	2036	2037
Direct Employment:					
Construction					
Shipbuilding, Repair	1,208	1,225	1,243	1,260	1,278
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	1,200	1,217	1,235	1,252	1,270
Earnings/Worker ($1986):					
Construction					
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Commercial Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					
Shipbuilding, Repair	22.9	23.2	23.5	23.9	24.2
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	22.5	22.9	23.2	23.5	23.9
Employment Multiplier	1.5000	1.5000	1.5000	1.5000	1.5000
Total Indirect Jobs	600	608	617	626	635
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	11.7	11.9	12.1	12.2	12.4
Earnings Multiplier	1.5195	1.5194	1.5193	1.5193	1.5192
TOTAL EMPLOYMENT IMPACT	1,800	1,825	1,852	1,878	1,905
TOTAL EARNINGS IMPACT	34.3	34.8	35.3	35.8	36.3
Mobile County Property Tax Revenue per $1 of Earnings	0.00552	0.00552	0.00552	0.00552	0.00552
Increase in Property Tax Revenue ($000 1986)	189.1	191.8	194.7	197.4	200.2

Table A-2 (continued)
Regional Economic Impact of Bayou La Batre Project
Region: Mobile County

	2038	2039	2040	2041	Average
Direct Employment:					
Construction					---
Shipbuilding, Repair	1,295	1,314	1,332	1,351	937
Commercial Fishing	-8	-8	-8	-8	-8
TOTAL DIRECT EMPLOYMENT	1,287	1,306	1,324	1,343	895
Earnings/Worker ($1986):					
Construction					25,225
Shipbuilding, Repair	18,936	18,936	18,936	18,936	18,936
Commercial Fishing	39,292	39,292	39,292	39,292	39,292
Direct Earnings (Millions of $1986):					
Construction					---
Shipbuilding, Repair	24.5	24.9	25.2	25.6	17.8
Fishing	-0.3	-0.3	-0.3	-0.3	-0.3
TOTAL DIRECT EARNINGS	24.2	24.6	24.9	25.3	16.8
Employment Multiplier	1.5000	1.5000	1.5000	1.5000	1.5000
Total Indirect Jobs	643	653	662	671	447
Earnings/Worker ($1986)	19,527	19,527	19,527	19,527	19,527
TOTAL INDIRECT EARNINGS	12.6	12.7	12.9	13.1	8.7362
Earnings Multiplier	1.5192	1.5191	1.5191	1.5190	1.5169
TOTAL EMPLOYMENT IMPACT	1,930	1,959	1,986	2,014	1,342
TOTAL EARNINGS IMPACT	36.8	37.3	37.8	38.4	25.5
Mobile County Property Tax Revenue per $1 of Earnings	0.00552	0.00552	0.00552	0.00552	0.00552
Increase in Property Tax Revenue ($000 1986)	202.9	205.9	208.8	211.8	140.9

APPENDIX B. LIST OF CONTACTS

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APPENDIX D. GLOSSARY

Autonomous Spending: In a macroeconomic model of a national economy, all purchases not related to income are autonomous: investment, government purchases of goods and services, exports, and autonomous consumption. In a regional economy, autonomous spending includes all purchases which originate, or are funded, from outside the region. (See also External Demand, Final Demand.)

Backward Linkages: Purchases of inputs by a firm within a region from other firms in the same region.

Basic Industries: Regional industries which sell all or part of their output to buyers outside the region.

Crosshauling: Occurs when firms purchase inputs (or consumers purchase consumer goods) from firms in another region while at the same time, regional suppliers of the same input (or consumer good) sell their output to firms (or consumers) in another region.

Direct Output, Employment, or Income: The output produced directly as the result of an investment in a region, and the jobs and income created by the production process.

Econometric Model: A system of equations designed to describe the economic relationships both within a regional economy and between the regional and national economies. The parameters of the equations are estimated statistically, and the model is then used for forecasting regional economic activity.

Exogenous: Originating from outside, as in outside a region. For an economic model, an exogenous variable is one not estimated by the model itself, a "given."

Export Demand: Demand from outside a region for the products or services produced within the region.

External Demand: See Export Demand.

Final Demand: In an input-output model, final demand is the total of demand by regional consumers for consumption goods, demand by regional producers for investment goods, and export demand.

Forward Linkages: Demand for regional consumer goods resulting from the income produced in a given economic activity.

Gravity Potential Model: A model that relates the economic interactions between two (or more) places directly to some measure of attraction (i.e., total population) for each place, and inversely to some measure of the distance between the places.

Indirect Output, Employment, or Income: The output, employment, or income created in other industries, via backward and forward linkages, by an increase in output of a given industry. (See also Multiplier.)

Injection: A quantity of expenditure in a region originating outside the region. (See also Export Demand.)

Input-Output Table: A table which shows the purchases of inputs by each industry in a region from each other industry in the region, from industries outside the region, and from households in the region (i.e., labor); and the sales of each regional industry to other industries in the region, to buyers outside the region, and to households in the region.

Leakages: Consumer income which is not used to purchase goods and services from regional producers is said to "leak" out of the spending stream. The principal leakages from a region are federal taxes, saving, and imports.

Location Quotient: The ratio of the percentage of total regional employment (or income or output) in industry i to the corresponding percentage of national employment in industry i. When a location quotient exceeds 1.0, the region is thought to export part of its output to other regions.

Macroeconomy: An economy viewed as a whole. Macroeconomic study is concerned with total output, employment, and income for a regional or national economy.

Multiplier: The ratio of the total economic change produced (via backward and forward linkages) by an autonomous change in a given part of a regional economy. Multipliers may be defined for output, employment, or income.

Nonbasic Industries: Regional industries which produce output primarily for consumers in the same region.

Regional Purchase Coefficient: The proportion of a given input which is purchased by regional industry i from suppliers in the same region. Used in input-output models.

Respending: When the purchase of a good produced in a region creates income for regional households, those households will spend some of the additional income on other goods produced in the region. Then the additional income created by that spending will be partially used to buy still more regional goods. This process is called respending.

Technical Coefficient: The amount of input from industry j necessary to produce one dollar's worth of output of industry i. Used in input-output models.

Time Series Models: Economic models which predict future economic activity based upon past economic activity.

USER INSTRUCTIONS

The STRATEGICA economic impact model will be provided to the Mobile District on computer diskette, in the form of a Lotus 1-2-3 spreadsheet for Alabama, and another for Mobile County. The top portions of the spreadsheets are reproduced as Tables A-1 and A-2. The reader is advised to refer to the tables while reading the user instructions.

The user instructions are designed to enable Mobile District staff to simulate project impacts for a variety of alternative assumptions. Users can change direct employment impacts, earnings per worker in different industries, multipliers, effective tax rates, and discount rates to simulate the effects on total regional employment, earnings, and tax revenues.

User-Supplied Inputs

To begin, call up the relevant Lotus spreadsheet (BLBALA.WKS for Alabama; BLBMPB.WKS for Mobile County). Save the spreadsheet so that the original is not lost.

The user need only supply direct employment impacts in the construction, shipbuilding and repair, and commercial fishing industries, to estimate the economic impacts of the project. Just replace the direct employment figures in the spreadsheet with alternative estimates, and all other data will be automatically recalculated.

If you wish to save the results of your simulation, rename and save the new spreadsheet.

Changes in Parameters

Employment Multipliers

Replace the construction multiplier in the 1989 column with another; the change will be automatically carried forward to 1990. Similarly, if the shipbuilding multiplier in the 1991 column is changed, the change will automatically be applied to each future year. (The RIMS multipliers available from EIFS would be a good substitute.).

Earnings per Worker

Earnings per worker for any industry can be changed in the first column they appear; the changes will be carried forward to future years. (This would be useful when updating the estimates to 1987 dollars, for example.)

Tax Rates

Revise any tax rate in the first column it appears and the revision will be automatically carried forward to all future years. (This might be nacessary if effective tax rates change over time.)

Other Applications

As the user becomes familiar with Lotus 1-2-3, and with the STRATEGICA model, many more complex simulations will become possible. For example, the model can be applied to other kinds of projects with impacts on other industries. Earnings per worker can be trended up over time to estimate current dollar impacts. Multipliers can be adjusted over the life of the project to allow for technological change. These and other applications will suggest themselves to the frequent user.

APPENDIX D

ENVIRONMENTAL COMPLIANCE

BAYOU LA BATRE, ALABAMA
APPENDIX D
ENVIRONMENTAL DOCUMENTATION

SECTION D-1

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SECTION D-2

SCOPING CORRESPONDENCE

April 8, 1987

Coastal Environment Section

Mr. James W. Warr
Deputy Director
Alabama Department of Environmental
Management
1751 Federal Drive
Montgomery, Alabama 36130

Dear Mr. Warr:

Our June 1985 reconnaissance level studies concerning navigation improvements at Bayou La Batre, Alabama, recommended that more detailed, feasibility studies on commercial navigation and related water resource needs were warranted. In light of this recommendation, a Notice of Intent to Prepare a Draft Environmental Impact Statement (DEIS) was published in the Federal Register, December 24, 1986. As part of the scoping process as outlined in the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (40 CFR Part 1501.7), we are requesting your input in identifying significant resources and issues which should be addressed in the feasibility studies concerning channel improvements at Bayou La Batre. A map of the study area is enclosed. Even though we believe that many of the resources and issues have been identified through your efforts on the Mississippi Sound and Adjacent Areas Study and informal coordination on this study, we want to ensure that all significant issues are identified prior to coordination of the draft Environmental Impact Statement in August 1987.

Preliminary determinations indicate that channel improvements would involve deepening existing channels to approximately 20 feet. This would result in new work quantities of approximately 3 million cubic yards with maintenance activities involving approximately 30 percent greater amounts than current quantities. Disposal options currently being considered include use of existing disposal areas, upland sites, open-water disposal, Gulf disposal, island nourishment and oyster reef creation.

To assist us in meeting our current schedule, we would appreciate receiving your comments by May 4, 1987. Any questions should be addressed to Dr. Susan Ivester Rees of our Coastal Environment Section at (205) 690-2724 or FTS 537-2724. Thank you for your assistance in this important matter.

Sincerely,

N. D. McClure, IV
Chief, Environment and Resources
Branch

Enclosure

SAME LETTER SENT TO: SEE ATTACHED LIST

List of addressees:

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Mayor of Bayou la Batre
Bayou Ia Batre, Alabama 36509

Mr. Tyler Peck
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Guy Hunt
Governor

April 16, 1987

Mr. N. D. McClure
Chief, Environment and Resources Branch
Mobile District, Corps of Engineers
P. O. Box 2288
Mobile, AL 36628-0001

Re: Channel improvements at Bayou La Batre

Dear Mr. McClure:

This letter is written in response to your April 8, 1987 letter requesting ADEM's input regarding significant resources and issues which should be addressed in feasibility studies for channel improvements at Bayou La Batre. ADEM offers the following suggested topics for inclusion in the feasibility studies:

1. Dredged Material Contamination. The combination of historical Bayou usage and Corps of Engineers sediment data from 1974 and 1982 indicate the presence of heavy metals and oil and grease in significant quantities. The means by which these contaminated sediments will be dredged, handled, and disposed that will prevent the reintroduction of contaminants to the coastal environment should be identified and fully described.

2. Disposal Options. Disposal options should be identified. The description should include the manner in which dredged materials will be contained, the manner in which disposal will prevent a reintroduction of contaminants to the coastal environment, and the manner and extent to which degradation of estuarine fauna and wetland flora will be prevented. If open-water disposal options (other than Deep Gulf) are considered, a quantitative assessment of the disposal area's productivity and impacts of open-water disposal should be made.

3. Indirect Impacts. Since the federally supported construction of a deeper-draft channel should eventually result in an increased level of industrial/commercial waterfront development, the feasibility study should address indirect impacts to regulated resources such as wetlands, waterbottoms, fisheries habitat, and others. Presently there exist numerous

wetland areas and tidal arms that are undeveloped and have significant natural function. Since past experience with new federal projects (such as the Theodore Industrial Canal) tells us that undeveloped properties adjacent to federal navigation projects become more valuable from a development perspective, a feasibility study should address projected losses of living resources and could propose management strategies consistent with existing federal, state, and local authorities.

The Alabama Department of Environmental Management appreciates this opportunity to provide input to the Corps' Planning Program. Please contact me at your convenience if you have any questions. I encourage open communication on these issues and wish to be kept apprised of your project schedule and planning efforts.

Sincerely,

Bradley W. Gane
Environmental Scientist

BG/ct

Alabama Department of Economic And Community Affairs

GUY HUNT
GOVERNOR

FRED O. BRASWELL III
DIRECTOR

April 7, 1988

Colonel Larry S. Bonine
Commander
U. S. Army Corps of Engineers
109 St. Joseph Street
Post Office Box 2288
Mobile, Alabama 36628-0001

Dear Colonel Bonine:

For the past several months Alabama, Mississippi and Corps of Engineers officials have been discussing the possibility of using shallow and deep water dredge disposal materials as a means to reestablish coastal eroded islands and berms. Historically these areas have served as buffers to adjacent wetland and shrimp and oyster habitats.

Based on unofficial reports Alabama's loss and/or degradation of barrier islands and sand bars has resulted in significant declines in oyster reefs and wetlands. As a result it is our belief that the reestablishment of these islands and/or sand bars will reverse this trend and be a positive benefit to the Alabama and Mississippi coastal environment.

Therefore, we support the U. S. Army Corps of Engineers evaluating the possibility of high grade dredge materials being used for coastal island and sand bar recreation. If you need additional information and/or assistance in regard to this matter please feel free to contact Walter B. Stevenson, Jr. of ADECA at (205) 284-8735.

Sincerely,

Fred O. Braswell, III

FOB:WBS:asf

3465 Norman Bridge Road • P.O. Box 2939 • Montgomery, Alabama 36105-0939 • (205) 284-8700

STATE OF ALABAMA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
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GUY HUNT
GOVERNOR

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COMMISSIONER
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ASSISTANT COMMISSIONER

HUGH A. SWINGLE, DIRECTOR
DIVISION OF MARINE RESOURCES

5/4/87

Ms. Susan Rees
Coastal Environment Secti
Mobile District, Corps of Engineers
P.O. Box 2288
Mobile, AL 36628-0001

Dear Susan,

As we discussed in our phone conversation in reference to the navigation improvements at Bayou La Batre, Alabama, I think that most of the major issues have probably been considered. I would, of course, ask that all environmental impacts be considered throughout the planning stages. I am particularly concerned about any impact the improvements and subsequent maintenance work will have upon the estuarine nursery areas adjacent to the work area. Please keep in mind that these impacts could be indirect such as changes in hydrology in the area.

As you mentioned upland disposal of spoil will probably be necessary within the bayou to avoid congestion. In the open water area I think the first choice would be island nourishment accomplished by creating an underwater berm east of Petite Bois Island beyond Petite Bois Pass. Hopefully, this technique will be proved successful from the work southeast of Dauphin Island.

Second choice for lower channel dredge disposal would be thin layer dispersion similar to the case at East Fowl River, if no adverse effects are observed in that case.

Please let me know about concerns others express. I will continue to think about this project and let you know if I think of anything else. I realize this project is extremely important to the economy and prosperity of Bayou La Batre.

Sincerely,

Steve

Stevens R. Heath
Assistant Chief Biologist

GULF OF MEXICO FISHERY MANAGEMENT COUNCIL
Lincoln Center, Suite 881 • 5401 W. Kennedy [illegible]
Tampa, Florida 33609 • Phone 813/[illegible]

April 30, 1987

N. D. McClure, IV
Chief, Environment and Resources Branch
Department of the Army
Mobile District, Corps of Engineers
Post Office Box 2288
Mobile, Alabama 36628-0001

Dear Mr. McClure:

The Gulf of Mexico Fishery Management Council (Council) is one of eight regional Fishery Management Councils established by the Magnuson Fishery Conservation and Management Act of 1976 (Public Law 94-265). The Council prepares fishery plans which are designed to manage fishery resources in the 200-mile limit in the Gulf of Mexico. The Council is concerned with proposed changes in the environment that may affect marine fishery resource.

In particular the Council would be concerned with possible impacts of this project on two estuarine dependent species for which management plans exist: shrimp and red drum. Therefore, the DEIS should address at a minimum, the likely impact on these resources of the various project options.

Identification of the shrimp and redfish sources is for emphasis on the resources being managed by the Council. The DEIS should, as you recognize in your letter, address the resources and issues identified in the Mississippi Sound and Adjacent Areas Study.

Sincerely,

Wayne Swingle

Wayne E. Swingle
Executive Director

WES:PJH:plb

cc: Habitat and Environmental Protection Management Committee
Florida/Alabama Habitat and Environmental AP
Staff

SECTION D-3

SECTION 404 (b)(1) EVALUATION FOR
PROPOSED NAVIGATION IMPROVEMENTS AT
BAYOU LA BATRE, ALABAMA

SECTION 404 (b)(1) EVALUATION
FOR
NAVIGATION IMPROVEMENTS
AT
BAYOU LA BATRE, ALABAMA

Introduction. Bayou La Batre is a tidal stream about 10 miles long which empties into Mississippi Sound about 30 miles southwest of Mobile, Alabama. Nearly all of the navigable lengths of the bayou and its tributaries are within the corporate limits of the town of Bayou La Batre, Alabama. The existing Federal navigation project at Bayou La Batre provides for a channel from the 12-foot contour in Mississippi Sound northward to the Highway 188 bridge (See Figure 404-1). The proposed plan to provide navigation improvements at the Bayou La Batre Federal Navigation Project requires the deepening of the existing channel alignment within the bayou, the provision of a channel above the Highway 188 bridge for a distance of 1500 feet, the provision of a channel in Snake Bayou for a distance of 1347 feet, deepening and widening the existing channel in Mississippi Sound, provision of a channel from the 12-foot contour in Mississippi Sound southward to the Gulf Intracoastal Waterway (GIWW) crossing, and provision of a channel westward along the GIWW alignment to the Pascagoula Ship Channel (See Figure 404-2).

I. Project Description. Materials to be removed from the Bayou La Batre channel alignments will be disposed in an existing upland disposal site, a new upland disposal site, a shallow open water placement area adjacent to the northeast shore of Isle aux Herbes, open water disposal sites restricted to depths of 12 feet or greater approximately 2500 feet west of the Mississippi Sound channel segment, and open water disposal sites in depths of 18 feet or greater approximately 5000 feet south of the GIWW channel segment. Approximately 567,300 cubic yards of new work and 4,360,000 cubic yards of maintenance material would be placed in the upland disposal sites over the life of the project. Approximately 1.3 million cubic yards of new work material would be utilized to construct an emergent berm along the northeast shore of Isle aux Herbes. Approximately 700,000 cubic yards of new work and 7.3 million cubic yards of maintenance material would be placed in the open water sites 2500 feet west of the Mississippi Sound channel segment. Approximately 485,554 and 1.5 million cubic yards of new work and maintenance material, respectively, would be placed in the open water sites 5000 feet of the GIWW channel segment over the life of the project. See Pages 86 - 91 of the Main Report and pages EIS-6 - EIS-19 for a more detailed description of the tentatively selected plan and alternatives to that plan. Refer to Table 404-1 for a detailed breakdown of quantities to be dredged and disposal sites to be utilized.

a. Authority and Purpose. The existing Federal project was authorized by the 1965 River and Harbor Act (H.Doc. 327, 88th Congress, 2nd Session) and prior acts. The authority for the study of navigation improvements is contained the House Public Works Committee Resolution adopted on October 10, 1974. The resolution requested feasibility studies

to determine if modifications to the existing navigation project at Bayou La Batre are warranted. Additional details concerning public concerns and planning objectives are provided in Section V of the Main Report.

b. Description of the Proposed Dredged and Fill Materials.

(1) General characteristics. The fill material that would be placed in the Mississippi Sound open water disposal sites consists predominately of inorganic clays of high plasticity, poorly graded sands, sand-clay mixtures and inorganic clays of low to medium plasticity.

(2) Quantity of material proposed for discharge. Refer to Table 404-1.

(3) Source of materials. The dredged material would be obtained by dredging the channel alignments within Mississippi Sound which are within 2500 and 5000 feet of the proposed disposal sites, except for the Isle aux Herbes site. The Isle aux Herbes site is approximately 2 miles east of the channel.

c. Description of the Proposed Discharge Sites.

(1) Location and areal extent. The Isle aux Herbes shallow open water disposal site is located adjacent to the northeast shoreline of the island in the vicinity of the 3-foot contour (See Figure EIS-5). The open water disposal sites for the Mississippi Sound channel segment are located in water depths greater than 12 feet west of the channel. Approximately 600 acres are required for disposal of new work material and approximately 415 acres will be utilized during each maintenance cycle depending upon dredging needs. The open water disposal sites for the GIWW channel segment are located in water depths 18 feet or greater approximately 5000 feet south of the channel. Approximately 330 acres are required for disposal of new work material. Approximately 90 acres will be utilized during each maintenance cycle depending upon dredging needs (See Figure 404-2). For a more detailed discussion of these sites refer to pages 36 - 40 of the Main Report and pages EIS-21 - EIS-22.

(2) Type of discharge site. The open water disposal sites are typical of eastern Mississippi Sound with substrates composed predominately of silt and clay with varying percentage of sand. A portion of the proposed discharge site at Isle aux Herbes was the subject of an EA/FONSI and 404(b)(1) Evaluation prepared April 30, 1982.

(3) Method of discharge. The material would be placed on the sites using a hydraulic cutterhead/pipeline dredge.

(4) When would disposal occur? Disposal is scheduled to begin in 1990.

(5) Projected life of discharge site. The proposed life of the disposal sites is 50 years with the exception of the Isle aux Herbes site which will only be utilized one time.

II. Factual Determinations.

a. Physical Substrate Determinations.

(1) Substrate elevation and slope. The proposed disposal site at Isle aux Herbes varies between -2 to -4 feet Mean Low Water (MLW). The proposed open water disposal areas adjacent to the Mississippi Sound channel segment vary between -12 to -18 feet MLW. The proposed disposal areas adjacent to the GIWW segment are essentially flat, varying between -18 and -20 feet in depth. bay bottoms which varies in elevation from -12 to -18 feet Mean Lower Low Water (MLLW). These depths are adequate to support the disposal of dredged material for the proposed 50-yeaı project life.

(2) Sediment type. Soils within Mississippi Sound consist of inorganic clays of high plasticity, poorly graded sands, sand-clay mixtures, sand-silt mixtures, and inorganic clays of low to medium plasticity. Sandy material begins to show up in the soil profile in the area just south of the GIWW and becomes dominant through the tidal pass into the Gulf of Mexico. Firm to stiff clays are encountered throughout the channel at depths of -18 MLLW in the northern portion of the sound to -22 MLLW in the vicinity of the GIWW. See page 13 of the Main Report for a more detailed discussion of sediment type.

(3) Dredged or fill material movement. With the exception of the Isle aux Herbes disposal site, the proposed open water disposal sites are unconfined. With respect to the Mississippi Sound segment, the disposal areas are 2,500 feet west of the channel, and, in the case of the GIWW segment the disposal areas are 5,000 feet south of the channel. The dredged material, when placed into the open water areas, will be subject to mud flows and wind and wave resuspension. Information obtained from the Mississippi Sound and Adjacent Areas Study (US Army Corps of Engineers, 1984) suggests that the disposal areas have been appropriately situated and that movement of dredged material back into the channel would not occur. Over time it should be expected that daily wind and wave action, as well as storm events, would cause the material to be dispersed from the actual disposal areas. Approximately 160 acres adjacent to the northeast shore of Isle aux Herbes will be confined utilizing hay bales (See Figure EIS-5). A double row of bales, two bales high, would be established east of the 3-foot contour and a single row of bales would be placed east of the existing shoreline. Each of these rows would attach to the shoreline on the north and south boundaries. The placement of materials would generally be along the 3-foot contour, beginning in the north and proceeding southward. The resultant emergent berm would be approximately 6 feet high (3 feet above MLW). Over time the hay bales would degrade and the berm would be allowed to naturally erode.

(4) Physical effects on benthos. Benthic organisms in the Isle aux Herbes disposal area will be buried and replaced with forms more suited to an intertidal habitat. Direct placement of the new work dredged material in the open water sites adjacent to the Mississippi Sound and GIWW channel segments will result in a layer of material approximately 2 feet

thick being placed on the bottom. Most sessile benthic organisms will be smothered by this layer, however some of the more motile forms will be able to escape. Repopulation of these areas may take from 12 to 18 months. Placement of the maintenance material in a thin layer, 1-foot or less, would smother some benthic forms however it is likely that a larger number of organisms will be able to migrate through the layer or escape. A recent study of the impacts of thin layer disposal of maintenance sediments from the Fowl River navigation project, in Mobile County, Alabama (TAI, 1988), suggests that the approximately 350 acre Fowl River disposal area recovered within 6 months after coverage with approximately 1 foot of dredged material. While this study does not suggest that all bay bottoms react similarly to these perturbations, it does suggest that thin-layering of dredged materials may allow faster recovery of bay bottoms either through repopulation or through migration up through the dredged material overburden.

(6) Actions taken to minimize impacts. No other actions to minimize impacts to the physical substrate are deemed appropriate for this project.

b. Water Circulation, Fluctuation, and Salinity Determinations.

(1) Water. Increases in dissolved and total organic carbon, dissolved ammonia, nitrate and total Kjeldahl nitrogen levels would be associated with disposal however, these increases are expected to be short-term in nature and therefore no significant impacts are expected to result from the proposed open water disposal activities. Ambient conditions in the Bayou La Batre study area are turbid; however, it is recognized that during open water disposal of dredged material that turbidity plumes and mud flows occur, both of which tend to reduce water clarity. This condition would prevail during the disposal operations but would be restricted to the area of disposal. Color would be affected during disposal with the water appearing darker due to the presence of a 'plume' from the discharge of silt and clay material. This would be a temporary condition which would cease shortly after disposal ceases. There would be no significant impacts on o[illegible] taste, or eutrophication characteristics due to the open water disposal activities.

(2) Current patterns and circulation. Circulation patterns within the area are controlled by astronomical tides, winds, and to a lesser degree, freshwater discharge. For more detail refer to pages 21 - 14 of the Main Report. Use of the [illegible]ed Isle aux Herbes disposal area would have no impact on current patterns or circulation. Disposal of new work material adjacent to the Mississippi Sound and GIWW channel segments would cause localized impacts on circulation, however since these areas are in water depths of 12 feet or greater and are remote from the shoreline these impacts are not considered significant. Disposal of maintenance material in the proposed open water sites would have no significant effect on circulation. Studies done during the Mississippi Sound and Adjacent Areas Study (US Army Corps of Engineers, 1984) indicate that circulation is predominately toward the west in this area therefore the proposed disposal areas have been located west or south of the proposed channel alignments.

(3) Normal water level fluctuations. There would be no change in normal water level fluctuations as a result of use the proposed open water disposal sites.

(4) Salinity gradients. Salinities in Mississippi Sound are highly variable in response to freshwater inflow and influence of the Gulf of Mexico. Results of studies on use of open water disposal areas and channel improvements at Pascagoula, Mississippi indicated that use of the open water disposal sites did not result in alteration of salinity gradients and that only slight localized changes in salinity resulted from deepening that channel from 38 to 42 feet. Based on this information the use of the proposed disposal areas would have no impact on salinity structure of Mississippi Sound.

(5) Actions taken to minimize impacts. No other actions that would minimize impacts on water circulation, fluctuation and salinity are deemed necessary.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected changes in suspended particulate and turbidity levels in the vicinity of the disposal site. Localized short-term increases in suspended particulate levels may occur at the time of disposal, however these increases would be within the range of ambient turbidities for this area and would not violate state water quality standards.

(2) Effects on the chemical and physical properties of the water column. Decreases in the degree of light penetration and dissolved oxygen concentration would occur during disposal activities, however these changes would be localized and short-term in nature.

(3) Effects on biota. Effects on the biota of the proposed open water disposal sites would be insignificant since the biota of this area are adapted to periodic increases of suspended material due to storm related events and annual high freshwater inflows from Mobile Bay.

(4) Actions taken to minimize impacts. No further actions are deemed appropriate.

d. Contaminant Determination. Past studies of sediments from within the bayou and in Mississippi Sound indicated highly variable concentrations of nutrients, heavy metals, high molecular weight hydrocarbons, and pesticides. Mercury, arsenic, copper, zinc, cadmium, and lead were found to occur in concentrations greater than crustal abundance. In addition pesticides such as chlordane, DDD, DDT, and dieldrin, and PCB's had been reported from the area. Sediment test performed by the Environmental Protection Agency (1988) on samples from three locations in the proposed channel indicated that the toxicity of each of these was minimal. Exposure to the sediments for 10 days had little observable adverse effect on oysters or pink shrimp. Survival of polychaetes was less

than desirable; however, there was not a location-specific effect with survival being 62% in the reference sediment and 44%, 66%, and 50% in the channel sediments. Survival in 100% suspended particulate phase of mysids was greater than 80%. Residues of selected chlorinated hydrocarbon pesticides, PCBs, or chloplyrifos were not detected in sediments or animal tissues before or after exposure. Concentrations of metals in oysters and lugworms exposed to channel sediments were not significantly greater than concentrations from organisms exposed to reference sediments. Concentrations of zinc in shrimp tissues exposed to sediments from the bayou proper were higher than concentrations in tissues of animals exposed to reference sediments. Petroleum hydrocarbon residues were detected in some animal tissues but there were no statistically significant differences between reference and test animals (See Appendix D, Section 4).

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on plankton. Disposal of dredged material into open water would destroy some phytoplankton and zooplankton, and would reduce light penetration which may tend to affect primary production by the Phytoplankton. Studies conducted on the effect of maintenance dredging in a similar area in Mississippi Sound indicated that plankton are affected only in a localized area over a short period of time, and further concluded that the effects on the regional and local plankton systems are negligible (Water and Air Research, 1975).

(2) Effects on benthos. Open water disposal of new work material as proposed would smother many of the benthic organisms of the proposed disposal areas. In addition, the possibility exists that mud flows would disrupt additional organisms outside the limits of the disposal area. The extent to which this may be expected to occur is not considered significant. Benthic communities would re-establish within 12 - 18 months after disposal through immigration from outlying areas and through the settling of planktonic larvae of these forms. Disposal of maintenance material in a thin layer would also impact the benthic communities of the proposed disposal areas, however studies indicate that these areas begin to repopulate within as little as 6 weeks after cessation of disposal and that no significant differences between disposal and reference areas exist within 20 weeks after disposal (TAI, 1988). The benthic communities which characterize the Mississippi Sound area are adapted to highly variable oceanographic conditions and are able to respond to natural perturbations such as sedimentation and storm induced sediment disturbance (Vittor, 1982).

(3) Effects on nekton. Some nekters in and around the open water disposal areas would probably vacate the area, at least until conditions become more favorable. All such organisms would not be expected to vacate; however, it is logical to assume that many would avoid an area of disturbance such as that associated with the discharge of dredged material. Some nektonic filter feeders may be killed as a result of being in the affected area and other organisms less capable of movement such as larval forms may be physically covered with dredged material. Studies associated with thin layer disposal of dredged material indicated no significant

impact on nektonic organisms due to disposal activities (TAI, 1988).

(4) Effects on aquatic food web. No significant effects.

(5) Effects on special aquatic sites.

(a) Sanctuaries and refuges. The proposed disposal of dredged material would not significantly affect any of the fish and wildlife resources which are designated for preservation or general use in the Coastal Area Management Programs of the State of Alabama or the State of Mississippi.

(b) Wetlands. Wetlands along the northeast shoreline of the Isle aux Herbes would be protected [illegible] ion with the construction of the emergent berm in the proposed disposal site. No wetlands would be filled during the proposed activity.

(c) Mud Flats. Some mud flats are associated with the northeast shoreline of the Isle aux Herbes. The proposed action would cover existing mud flats, however, additional mud flats and associated communities would develop on the slopes of the berm.

(d) Vegetated shallows. The existing vegetated shallows along the Point aux Pins and the north shores of the barrier islands would not be affected by the proposed activities.

(e) Coral reefs. Not applicable to this area.

(f) Riffle and pool complexes. Not applicable to this area.

(6) Threatened and endangered species. No threatened or endangered species or their critical habitat would be impacted by the proposed action.

(7) Other wildlife. No significant effects.

(8) Actions to minimize impacts. No other actions to minimize impacts on the aquatic ecosystem are deemed appropriate.

f. Proposed Disposal Site Determinations.

(1) Mixing zone determinations. The State of Alabama, Department of Environmental Management (ADEM) and the State of Mississippi, Bureau of Pollution Control (BPC) delineates mixing zones on a case by case basis. In all cases mixing zones would be restricted to as small an area as possible. Based on previous dredging/disposal actions at Bayou La Batre, AL and at Pascagoula, MS, it is felt that any reasonable mixing zone requirements established by the States would be met.

(2) Determination of compliance with applicable water quality standards. Water quality classifications for this area of Mississippi Sound is generally for swimming, fish and wildlife, and shellfish

harvesting. The use of the proposed disposal areas would not alter constituent concentrations established for this use and would be in compliance, to the maximum extent practicable, with all applicable water quality standards.

(3) Potential effects on human use characteristics.

(a) Municipal and private water supply. No significant effects.

(b) Recreational and commercial fisheries. Some impacts to fish and wildlife resources could occur depending upon timing of dredged material placement in the proposed open water sites, however these are not considered to be significant.

(c) Water-related recreation. No significant effects.

(d) Aesthetics. Dredging in late fall to early winter would miss the peak recreational season, however it is not possible to schedule to disposal activities during this time due to weather and the time required to complete the activities would be longer than this period. The presence of the dredge, dredge pipe, and associated water and land based equipment would be evident and would temporarily degrade aesthetic qualities of the area.

(e) Parks, national and historic monuments, national seashores, wilderness areas, research sites, and similar preserves. No significant effects.

g. Determination of Cumulative Effects on the Aquatic Ecosystem. The data and information presented suggest that the utilization of the proposed disposal sites would have no significant cumulative adverse effects on the aquatic ecosystem. Should excessive or rapid shoaling of the open water sites occur during the 50-year project life, modifications in disposal practices or disposal site use would addressed.

h. Determination of Secondary Effects on the Aquatic Ecosystem. The use of the proposed open water disposal sites as part of the improvements to the Federal navigation project at Bayou La Batre, Alabama, may result in induced impacts to wetlands adjacent to the channel. Approximately 13.1 and 7 acres of wetlands and shallow water bottoms, respectively, within the bayou proper are expected to be subject to development pressure within the life of the project. Development of these areas, either through dredging or filling, would require individual Department of the Army permits.

III. Findings of Compliance or Non-Compliance with the Restrictions on Discharge.

a. No significant adaptations to the guidelines were made relative to this evaluation.

b. A number of alternatives were considered during the planning

process including: (1) No action,

(2) Use of an open water disposal site adjacent to the Point aux Pins/Isle aux Dames shoreline,

(3) Use of a littoral zone disposal site east of Petit Bois Island and,

(4) Disposal of dredged material in the Mobile North or Pascagoula Ocean Dredged Material Disposal Sites (ODMDS).

c. The planned disposal of dredged materials would not violate any applicable State water quality standards.

d. The disposal operation would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

e. As required by the Coastal Zone Management Act, the proposed action is consistent with the Coastal Management Programs of the States of Alabama and Mississippi to the maximum extent practicable.

f. Use of the selected disposal sites would not harm any endangered or threatened species or any critical habitat. This action is being coordinated with the US Fish and Wildlife Service and the National Marine Fisheries Service as required by Section 7 of the Endangered Species Act.

g. The disposal operation would not violate the Specified Protection Measures for Marine Sanctuaries designated by the Marine Protection, Research, and Sanctuaries Act of 1972.

h. The proposed activity would not result in any significant adverse effects on human health or welfare, including municipal or private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife would not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values would not occur.

i. Appropriate steps to minimize potential adverse impacts of the discharge on aquatic systems have been included in this evaluation.

j. On the basis of the guidelines, the proposed sites for the discharge of fill materials are specified as complying with the requirements of these guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the aquatic ecosystem.

DATE: ____________________

LARRY S. BONINE
Colonel, Corps of Engineers
District Engineer

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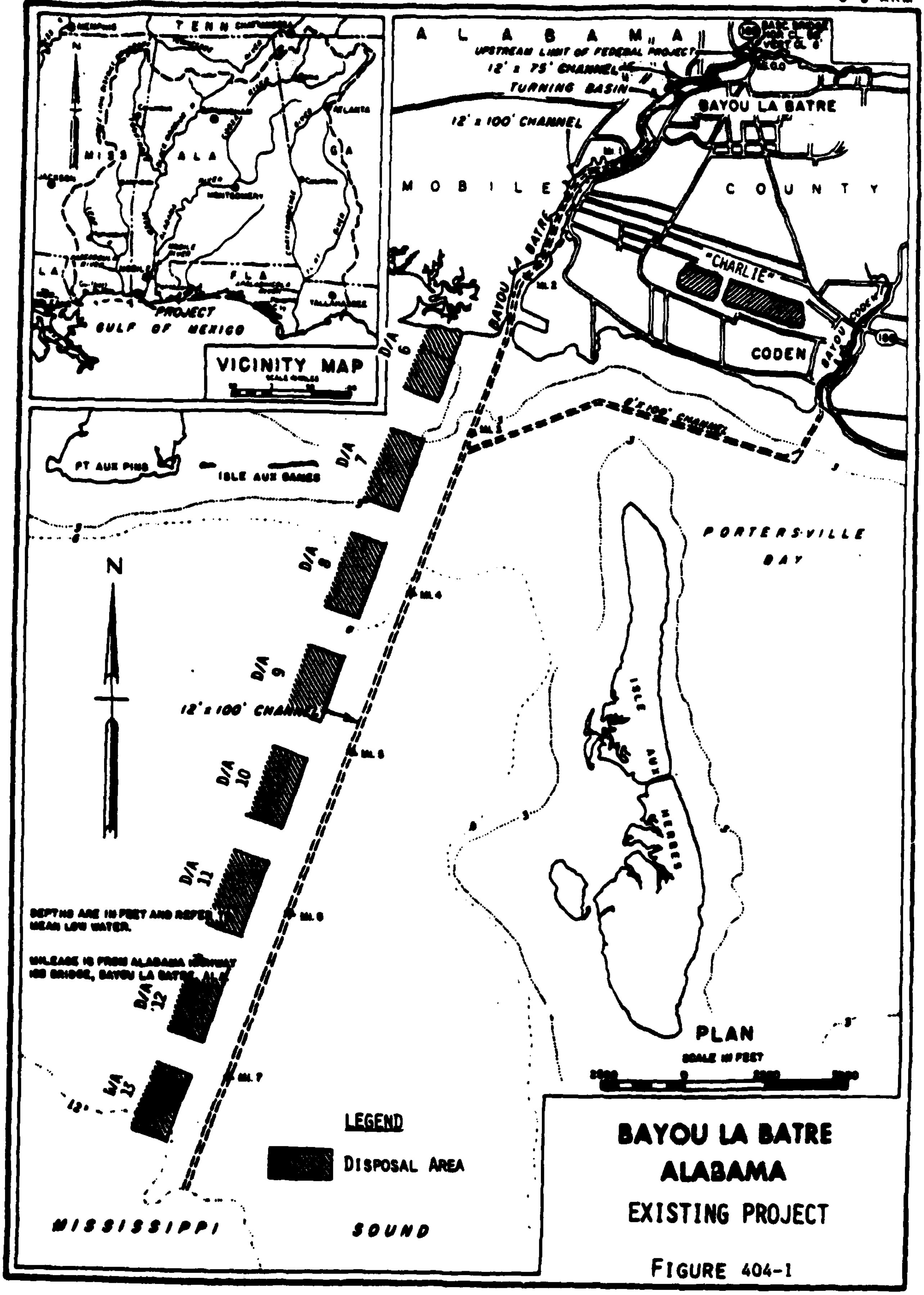
TABLE 404-1

CHANNEL REACH, DREDGING QUANTITY, DISPOSAL SITE MATRIX

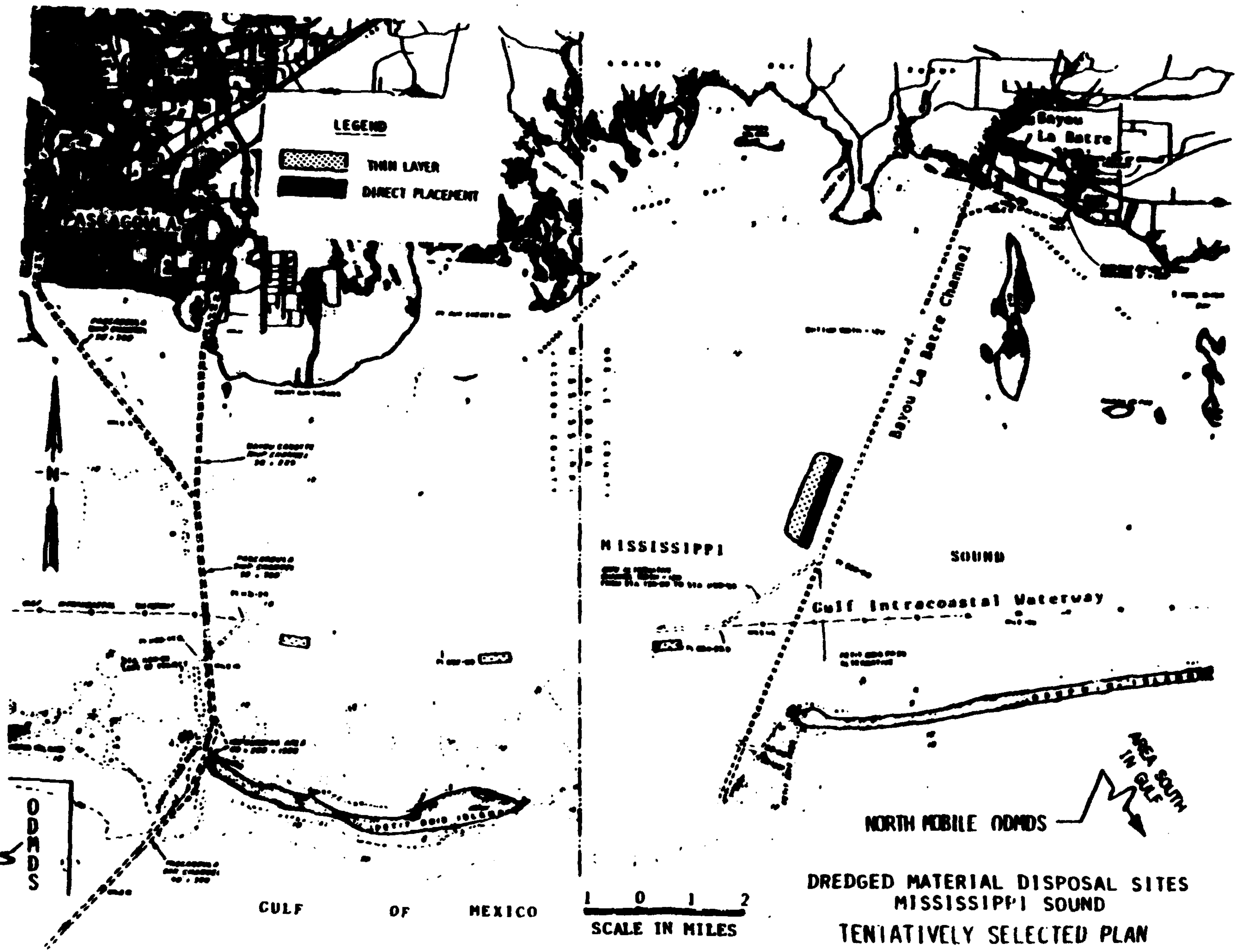
CHANNEL REACH	DREDGING QUANTITY		DISPOSAL SITES
BAYOU SEGMENTS			
Sta 90+45 to Sta -15+10	NW:	364,000	Upland 'Delta'
Snake Bayou	NW:	31,800	Upland 'Delta'
Sta 130+00 to Sta 90+45	NW:	171,500	Upland 'Charlie'
Sta 90+45 to Sta -15+10	O&M:	165,000	Upland 'Delta'
Snake Bayou	O&M:	10,000	Upland 'Delta'
Sta 155+00 to Sta 90+45	O&M:	80,000	Upland 'Charlie'
MISSISSIPPI SOUND	NW:	1,340,000	Isle aux Herbes
CHANNEL SEGMENT	NW:	700,000	Open Water >12' in Depth
	O&M:	430,000	Open Water >12' in Depth
GULF INTRACOASTAL WATERWAY (GIWW)	NW:	485,554	Open Water >18' in Depth
	O&M:	90,000	Open Water >18' in Depth

Notes: NW = New Work in cubic yards
O&M = Maintenance in cubic yards per 3 year maintenance cycle



BAYOU LA BATRE
ALABAMA
EXISTING PROJECT

FIGURE 404-1



DREDGED MATERIAL DISPOSAL SITES
MISSISSIPPI SOUND
TENTATIVELY SELECTED PLAN

FIGURE 404-2

SECTION D-4

EFFECTS OF SEDIMENT FROM THE BAYOU LA BATRE, ALABAMA, CHANNEL OF REPRESENTATIVE MARINE ORGANISMS

EFFECTS OF SEDIMENT FROM THE BAYOU LA BATRE, ALABAMA, CHANNEL ON REPRESENTATIVE MARINE ORGANISMS

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Final Report:

ABSTRACT

A toxicity and bioaccumulation test was conducted with sediment from three locations in the Bayou La Batre, Alabama, Channel. Three types of marine organisms from benthic and epibenthic habitats were exposed to sediment samples from each of the three sites for 10 days in flowing, natural seawater; a reference sediment from Grand Bay, Alabama, was used as a control. The purpose of the test was to evaluate, in the laboratory, the toxicity of the sediment samples and the potential for bioaccumulation of any chemicals from the sediments. In addition, a 96-hour toxicity test was conducted with the suspended particulate phase (SPP) of each sediment sample; the purpose was to compare toxicity of the whole sediment to that of the SPP. Because a test had been conducted with reference sediment collected from the same area six months earlier, a reference sediment SPP test was not conducted.

The toxicity of each of the three sediment samples was minimal. Exposure to the sediments for 10 days had little observable adverse effect on oysters (*Crassostrea virginica*) or pink shrimp (*Penaeus duorarum*). Survival of oysters was 96% in the reference sediment and $\geq$ 92% in Sites 1, 2, and 3; shrimp survival was 84% in the reference sediment and $\geq$ 78% in site 1 sediment. Although survival of polychaetes (*Neries virens*) was less than desirable, there was not a location-specific effect; survival was 62% in the reference sediment; 44% in Site 1; 66% in Site 2; and 50% in Site 3 sediment.

The SPP of each of the three sediments had little effect on mysids (*Mysidopsis bahia*). Survival in 100% SPP of all samples was $\geq$ 80%.

The results of the bioaccumulation test are reported in a separate document.

INTRODUCTION

In accord with an agreement with the U.S. Army Corps of Engineers (CE), Mobile District, tests were conducted with sediment from three locations in the Bayou La Batre, Alabama, Channel to determine toxicity to representative marine organisms and the potential for bioaccumulation of chemicals from the sediment samples. Ten-day tests with the solid phase (whole sediment) and 96-hour (h) tests with the suspended particulate phase (SPP) of each sediment sample and a reference sediment were conducted at the U.S. EPA Environmental Research Laboratory, Gulf Breeze (ERL/GB), Florida, during July-August 1987.

The chemical analyses of sediments and animal tissue also were conducted at ERL/GB, and the results are reported in a separate document.

MATERIALS AND METHODS

Test Materials

The reference and Site sediments tested were collected by CE, Mobile District, personnel on 25 June 1987 and transported to ERL/GB on the day of collection. The sediment samples and reference sediment samples were placed in a large cooler at ERL/GB and maintained at approximately 4°C. Before testing, the reference sediment was sieved to remove any large organisms; subsamples were combined and mixed well. The reference sediment was made up of larger particles than the Bayou La Batre sediments. The reference sediment was 47.2% silt-clay while all Channel sediments were $\geq$ 65.5% silt-clay. Silt-clay is defined as those particles < 62 micrometers (μm) (Folk 1957). A characterization of the Channel sediment samples and the reference sediment is contained in Table 1.

Sodium lauryl sulfate was used as a reference toxicant to gauge the condition of the test animals for the SPP tests. The chemical used was

manufactured by Sigma Chemical Company, No. L-5750, Lot 42F-0039, and was approximately 95% pure.

Test Animals

For the solid-phase (whole-sediment) tests, three types of marine organisms from benthic and epibenthic habitats were tested. They were polychaetes (*Neries virens*), oysters (*Crassostrea virginica*), and pink shrimp (*Penaeus duorarum*). The polychaetes were purchased from a bait dealer in New Castle, Maine; the oysters were purchased from a local commercial fisherman; and the shrimp were purchased from a local bait dealer. All animals were maintained for at least 48 h (h) at ERL/GB where they were acclimated to test conditions. There was no observed deaths of oysters or shrimp during the acclimation period. Those polychaetes that were not contracted and sluggish to respond when touched were not considered suitable for testing and were discarded.

Mysids (*Mysidopsis bahia*) for the SPP and reference toxicant tests were cultured at ERL/GB. Mysids (5 ± 1 days old) were fed *Artemia salina* nauplii (32 to 48 h post-hydration) during holding and testing.

Test Water

Natural seawater pumped from Santa Rosa Sound into the ERL/GB seawater system was used for all tests. For the solid-phase tests, the water was not filtered as it was pumped into elevated reservoirs. There it was aerated and allowed to flow by gravity into the wet laboratory, where it was siphoned from an open trough into the test aquaria. For the SPP tests, the seawater was filtered through sand and 20-μm fiber filters; salinity was controlled at 20 ± 2 parts per thousand by the addition of deionized water, and temperature was controlled at 25 ± 1°C by a commercial chiller and/or heater.

Test Methods

Test methods for the solid-phase tests were based on those of U.S. Environmental Protection Agency/Corps of Engineers (1977) and methods for the SPP tests were after U.S. Environmental Protection Agency (1985). To prepare for the exposure of polychaetes, oysters, and shrimp, approximately 7 liters (ℓ) of reference sediment was placed in each of fifteen 20-gallon (76-ℓ) glass aquaria. This resulted in a layer of reference sediment approximately 30 millimeters (mm) deep. After about 1 h, seawater flowed into each aquarium at approximately 25 ℓ/h, and the system was allowed to equilibrate for 24 h. After equilibration, the seawater flow was stopped, approximately 3.5 ℓ of the appropriate Bayou La Batre sediment was added to each aquarium (resulting in a layer about 15 mm deep), the sediment was allowed to settle for approximatley 1 h, and the seawater flow was resumed. Ten polychaetes were placed in the back section and 10 shrimp and 10 oysters were place in the front section of each aquarium. (A nylon screen, 2-mm mesh, had been inserted in each aquarium and secured with silicone sealant in order to separate the polychaetes from the predacious shrimp.) It should be noted that only 10 test organism per replicate, of each species were used for this test. The numbers were sufficient to perform a statistical analysis of mortality, and the individuals were of such a size that sufficient biomass was available for chemical analyses to determine bioaccumulation.

The five control (reference sediment) aquaria were prepared at the same time and in the same manner as the Bayou La Batre sediment exposure aquaria except that only the reference sediment was added to each aquarium.

The 10-day test was conducted from 28 July to 7 August 1987. Water temperature, salinity, pH, and dissolved oxygen were recorded daily. Dead animals were noted and removed from the aquaria daily. At the end

of the exposure, the remaining live animals in each aquarium were removed, rinsed with seawater to remove sediment, and were placed separately in flowing seawater to purge their gut. After 24 h, they were placed in acid-cleaned glass jars, then frozen, and later provided to the ERL/GB Chemistry Laboratory for chemical analyses to determine bioaccumulation. Animals from the test populations were treated similarly before the test began to provide information on background concentrations.

To prepare the suspended particulate phase (SPP) of each of the three Bayou La Batre sediment samples, 1,000 milliliters (mℓ) of chilled seawater was added to a 2-ℓ Erlenmeyer flask. Then, 200 mℓ of well-stirred sediment was added to the flask. More seawater (800 mℓ) was added to the flask to bring the contents to the 2-ℓ mark. This 1-part sediment:9-part seawater mixture was placed on a magnetic stirrer and mixed for at least 5 minutes, and then allowed to settle for 1 h. The SPP was then decanted into a separate container, and pH and dissolved oxygen (DO) concentrations were measured. The SPP of all the Bayou La Batre sediment samples had to be aerated to increase the DO to acceptable concentrations ($\geq$ 60% saturation). The appropriate volume of 100% SPP in seawater or seawater only was added to 2-ℓ Carolina culture dishes (the total volume in each dish was 1 ℓ) to prepare the test mixtures and control. The mixtures were then stirred for approximately 5 minutes (min); the DO, pH, temperature and salinity were measured; and test animals were added to the dishes. For all tests, twenty animals were placed in each dish in holding cups fabricated by gluing a collar of 363-μm mesh nylon screen to a 15-centimeter (cm) wide glass Petri dish with silicone sealant; the nylon screen collar was approximately 5 cm high.

After water quality measurements and addition of animals, the dishes

were stacked, with a cover on the top dish, and placed in an incubator. The temperature controller was set at 21°C and the light controller at 14 h light:10 h dark. The seawater in all treatments was aerated at a volume estimated to be 100 cubic centimeters/min during the tests. Air was delivered to each dish through polyethylene tubing (0.045-inch inner diameter and 0.062-inch outer diameter) by a small aquarium pump.

Water quality was measured at 24-h intervals, but daily counts of animals were not made because in some cases the turbidity of the sediments prevented 24-h observations of test animals. After 96 h, the tests were terminated. When necessary, the cups were flushed with seawater until the animals became visible, and live animals were then removed by pipette and counted. Suitability of the procedure was ensured by counting the control animals, placing them back in the holding cup and flushing them with seawater, and then recounting them.

Because the reference material was the same as that tested four months earlier in another dredged material test, no mysid acute toxicity test was conducted with the reference sediment.

Tests with the SPP prepared with sediment from Sites 1, 2, and 3 were conducted 14-18 July 1987; a reference toxicant test with mysids from the same population was conducted 22-26 June 1987.

Statistical Analyses

A one-way Analysis of Variance was performed on the survival data or polychaetes (SAS, 1982), but there were no statistical analyses of the data from the SPP tests because no median effect (50% mortality) occurred. Mortality data from the mysid reference-toxicant test were subjected to statistical analyses, however. The 96-h LC50 (the concentration lethal to 50% of the test animals after 96 h of exposure) were calcuated

by using the moving average method (Kendall and Stuart, 1973, and Stephan, 1977). The 95% confidence limits were also calculated.

RESULTS AND DISCUSSION

Sediment from three sites in the Bayou La Batre, Alabama, Channel had little observable adverse effect on oysters or pink shrimp after a 10-day exposure. Survival of oysters was 96% in the reference sediment and $\geq$ 92% in Site 1, 2, and 3 sediment; shrimp survival was 84% in the reference sediment and $\geq$ 78% in site sediment (Table 2).

The effect of the sediments on polychaetes was not conclusively determined because of the higher-than-desirable mortality in all treatments. Because there was similar survival (62%, reference sediment; 44%, Site 1; 66%, Site 2; and 50%, site 3), it did not appear that there was a location-specific effect. A one-way Analysis of Variance confirmed that there was no statistical difference ($\alpha = 0.05$) between polychaete survival in the reference sediment and in sediment from any of the three Channel sites. The reason for the poor survival is not known but we suspect that temperature may have been higher than ideal for this species of polychaete.

The suspended particulate phase (SPP) of the sediments did not cause significant adverse effects on mysids. When up to 100% SPP was tested, survival was $\geq$ 80% (Table 3). Results of the reference toxicant test showed that the mysids were in suitable condition for testing; the 96-h LC50 was 6.5 ppm with 95% confidence limits of 5.1 to 8.4 ppm. Our experience and the literature (Roberts et al., 1982) show that the 96-h LC50 of sodium lauryl sulfate for mysids in usually 5 to 8 ppm.

Water quality was satisfactory during the 10-day exposure with the sediment samples (Tables 4).

The results of the bioaccumulation test are reported in a separate document.

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Table 1. Characterization of three sediment samples from the Bayou La Batre, Alabama, Channel and a reference sediment from Grand Bay, Alabama, for water content and silt-clay (< 62 micrometers). Values reported are mean values.

Sediment	Water %	Silt-Clay (%)
Reference	29.3	47.2
Site 1	71.7	65.5
Site 2	69.9	95.3
Site 3	63.6	72.6

Table 2. Results of a 10-day laboratory exposure of polychaetes (Neries virens), oysters (Crassostrea virginica), and pink shrimp (Penaeus duorarum) to sediment from the Bayou La Batre, Alabama, Channel, along with a reference sediment. Numbers are animals that were alive at the end of the exposure; numbers of animals per replicate at the beginning of the test were 10 lugworms, oysters, and pink shrimp.

	Replicate	Polychaetes	Oysters	Shrimp
Reference Sediment	1	7	10	10
	2	5	10	9
	3	7	10	8
	4	7	10	8
	5	5	8	7
	Total	31	48	42
Site 1	1	6	10	9
	2	6	9	7
	3	3	10	8
	4	3	10	7
	5	4	9	8
	Total	22	48	39
Site 2	1	7	9	9
	2	7	9	10
	3	6	9	10
	4	6	9	10
	5	7	10	9
	Total	33	46	48
Site 3	1	3	10	6
	2	7	10	10
	3	5	9	8
	4	5	10	8
	5	5	9	10
	Total	25	48	42

Table 3. Results of acute toxicity tests conducted with mysids (*Mysidopsis bahia*) and the suspended particulate phase (SPP) of sediment from three sites in the Bayou la Batre, Alabama, Channel and a reference sediment from Grand Bay, Alabama. The percentage of animals alive after 96 hours of exposure is given.

	Exposure Concentration (% SPP[a])					
Test material	Control	1%	10%	25%	50%	100%
Reference Sediment[b]	---	---	---	---	---	---
Site 1	85	95	100	100	100	90
Site 2	95	100	100	55	100	80
Site 3	90	100	100	100	100	95

[a] The SPP (suspended particulate phase) was prepared by mixing 1 part sediment with 9 parts seawater (v:v), allowing the mixture to settle for 1 hour, and decanting the unsettled portion.

[b] Not tested because the same reference sediment was tested four months earlier.

Table 4. Water quality measurements during 10-day laboratory exposures of marine organisms to sediment from the Bayou La Batre, Alabama, Channel. The pH ranged from 8.0 to 8.2 in all aquaria for the period of the test.

	Test Day									
	1	2	3	4	5	6	7	8	9	10
Temp. (°C)	26.5	27.0	26.0	26.5	27.0	26.5	25.0	26.5	26.0	25.5
Salinity (‰)	25.0	26.0	26.0	26.0	26.0	26.0	24.0	24.0	25.0	26.0
DO (ppm)										
Reference										
Rep. 1	5.7	5.5	5.5	4.8	5.2	5.3	5.4	4.8	5.3	5.4
2	5.5	5.3	5.5	4.6	5.1	4.9	4.8	4.5	5.3	5.4
3	5.2	5.1	5.4	5.0	4.6	5.0	5.1	4.5	5.1	5.4
4	4.9	5.2	5.5	4.9	5.0	5.2	5.1	4.7	5.3	5.2
5	5.3	5.2	5.2	4.9	5.0	5.3	5.2	4.8	5.8	5.3
Site 1										
Rep. 1	5.2	5.2	5.3	5.1	4.7	5.3	5.1	4.6	5.1	5.4
2	5.5	5.1	5.4	5.3	5.3	4.8	5.3	5.0	5.5	5.3
3	5.5	5.5	5.4	5.2	5.0	4.8	5.5	4.4	5.5	5.4
4	5.5	5.8	4.6	5.3	4.8	5.0	4.9	5.2	5.0	5.7
5	5.8	5.6	5.3	5.0	4.9	5.4	5.4	4.7	5.6	5.7
Site 2										
Rep. 1	5.6	5.4	5.4	5.3	4.8	5.0	5.0	4.7	5.3	5.1
2	5.7	5.2	5.2	5.0	5.3	5.1	5.3	4.6	5.3	5.5
3	5.3	5.0	4.6	4.2	4.6	4.7	5.1	4.2	5.1	5.1
4	5.6	5.1	4.8	5.0	5.3	5.4	5.3	4.6	5.4	5.4
5	5.6	5.4	5.4	5.3	5.0	5.4	5.6	5.0	5.3	5.4
Site 3										
Rep. 1	5.1	5.2	5.0	5.2	5.2	5.3	5.2	4.1	5.4	5.3
2	5.5	5.4	5.2	5.2	4.9	5.0	5.2	4.8	5.3	5.3
3	4.6	5.1	4.9	4.4	5.4	5.2	5.1	4.4	5.4	5.4
4	5.6	4.7	5.4	5.5	5.1	5.4	5.5	4.5	4.8	5.6
5	5.4	4.9	4.0	4.6	4.8	4.7	5.0	4.8	3.8	5.0

SECTION D-5

CHEMICAL ANALYSES OF SEDIMENT FROM BAYOU LA BATRE, ALABAMA, AND TISSUES OF MARINE ORGANISMS EXPOSED TO THE SEDIMENT

CHEMICAL ANALYSES OF SEDIMENT FROM BAYOU la BATRE MISSISSIPPI, AND TISSUES OF MARINE ORGANISMS EXPOSED TO THE SEDIMENT

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ABSTRACT

Chemical analyses were performed on sediments from Bayou la Batre, Mississippi and on three types of marine organisms exposed to these sediment samples during a 10-day bioaccumulation test conducted by the Dredged Materials Research Team of the Gulf Breeze Laboratory. Five replicates of each sediment and type of organism were analyzed for residue of selected chlorinated hydrocarbon pesticides, PCBs, chlorpyrifos (Dursba petroleum hydrocarbons, and 9 heavy metals. The purpose of these chemical analyses was to determine if residues were detectable in the sediment and if they accumulated in tissues of organisms exposed to the sediment. Samples of each type of organism and sediment were analyzed prior to use in a bioaccumulation test.

Residues of selected pesticides or PCBs were not detected in sediment or animal tissues before or after exposure but several metals were detecte in sediments and in tissues of organisms before and after exposure. Using analysis of variance (ANOVA) at the 0.05 probability level, concentrations of metals in oysters (*Crassostrea virginica*) and lugworms (*Arenicola cristata*) exposed to sediment from sites 1, 2 or 3 were not significantly greater than concentrations of metals in animals exposed to a reference sediment. In shrimp (*Penaeus duorarum*), concentrations of zinc were significantly higher in animals exposed to Sites, 1 or 2 than concentrations of these metals in animals exposed to the reference sedimen Student-Newman-Kuels test was used to determine which sites were different from reference sediment.

Petroleum hydrocarbon residues were detected in some tissues of some lugworms, shrimp and oyster, but there were no statistically significant differences between tissue residues from animals exposed to site and

residues in tissues exposed to reference sediment were found. Although statistically significant differences were determined for selenium and zinc in shrimp, appropriate consideration should be given to the magnitude of these numbers. When differences between mean values for organisms exposed to sediment from a reference site and mean values for organisms exposed to a test site are not greater than an order of magnitude may not indicate a bioaccumulation potential without further confirmation by a more definitive study.

INTRODUCTION

In accord with an agreement between the U.S. Army Corps of Engineers (CE), Mobile District, and EPA's Gulf Breeze Environmental Research Laboratory (ERL/GB), chemical analyses were performed on sediment from Sites 1, 2 and 3 in Bayou la Batre, Mississippi and on three species (shrimp, oyster, and lugworm) of marine organisms exposed to these sediments during a bioaccumulation test. Five replicates of each sediment and organism were analyzed for the following chemical residues: PCBs, selected chlorinated hydrocarbon pesticides, chlorpyrifos (Dursban), selected heavy metals, and two petroleum hydrocarbon fractions (aliphatic and aromatic). These analyses were performed on sediments and organisms before the bioaccumulation test and on organisms after the bioaccumulation test. Chemical analyses were performed by gas-liquid chromatography for pesticides, PCBs, and petroleum hydrocarbons, and inductively coupled argon plasma emission spectroscopy (ICAP) for heavy metals. Methods of chemical analyses were modified and validated at ERL/GB, except for the petroleum hydrocarbon method. This method was used as recommended by the U.S. Army Corps of Engineers Implementation Manual (EPA/CE, 1977).

MATERIALS AND METHODS

Test Sediments and Animals

Samples of sediments and test organisms were obtained from the ERL/GB Dredged Materials Research Team prior to initiation of the bioaccumulation test. After the 10-day exposure period, five replicates of each test organism from each test sediment, and the reference sediment, were collected and maintained at approximately 4°C until chemical analyses were performed.

Methods of Chemical Analyses

A. Chlorinated Hydrocarbon Pesticides and PCBs

Tissue samples were weighed into a 150-mm by 25-mm screw-top test tube and homogenized three times with 10 ml of acetonitrile with a Willems Polytron Model PT 20-ST (Brinkman Instruments, Westbury, NY). Following each homogenization, the test tube was centrifuged (1600x g) and the liquid layer decanted into a 120-ml oil sample bottle. Seventy-five ml of a 2% (w/v) aqueous sodium sulfate and 10 ml of petroleum ether were added to the bottle and the contents shaken for 1 minute. After the layers separated, the solvent was pipetted into a 25-ml concentrator tube and the extraction with petroleum ether was repeated two more times. The combined solvent extract was concentrated to 1 ml on a nitrogen evaporator in preparation for cleanup.

Cleanup columns were prepared by adding 3 g of PR-grade florisil (stored at 130°C) and 2 g of anhydrous sodium sulfate (powder) to a 200-mm by 9-mm i.d. Chromaflex column (Kontes Glass Co., Vineland, NJ) and rinsing with 20 ml of hexane. Tissue and sediment extracts were transferred to the column with two additional 2-ml volumes of hexane. Pesticides and PCBs were eluted with 20 ml of 5% (v/v) diethyl ether in hexane.

Quantitations of pesticides were made with external standard methods. All standards were obtained from the EPA pesticide repository. PCB reference standard, obtained from U.S. EPA Chemical Repository, Washington, DC, was described by Sawyer (1978). Analyses were performed on a Hewlett-Packard Model 5710 gas chromatograph equipped with a ^{63}Ni electron-capture detector. Separations were performed by using a 182-cm by 2-mm i.d. glass column packed with 2% SP2100 (Supelco, Inc., Bellefonte, PA) on 80-100 mesh Supelcoport. Other gas chromatographic parameters were: flow rate of the 10% methane-in-argon carrier gas, 25 ml/min; column temperature, 190°C; inlet temperature, 200°C, and detector temperature, 300°C.

Recoveries of PCBs and pesticides from spiked samples and detection limits for pesticides and petroleum hydrocarbons are shown in Table 1. Results are reported to two significant figures in Tables 2 through 2d, as our methods allow.

B. Heavy Metals

One to two grams of tissue or sediment were weighed into a 40 ml reaction vessel. Five ml of concentrated nitric acid (Baker Chemical Instra-Analyzed) were added and the samples digested for 2 to 4 h at 70°C in a tube heater. Digestion was continued, with vessels capped, for 48 h at 70°C. After digestion, samples were transferred to 15-ml tubes and diluted to 10 ml for aspiration into a Jarrell-Ash AtomComp 800 Series inductively-coupled argon-plasma emission spectrometer (ICP). This instrument acquires data for 15 elements simultaneously. Method detection limits for each element are given in Table 3 and are based on wet weight analyses. No detectable residues could be found in method blanks. A solution of ten percent nitric acid/distilled water was analyzed between samples to prevent carryover of residues from one sample to the next. Standards were used to calibrate the

instrument initially and adjustments were made when necessary. Concentrations are reported in two significant figures as our method allows, and were not corrected for percentage recovery.

C. Petroleum Hydrocarbons

Ten grams of tissue or sediment were weighed into culture tubes and extracted as described by J.S. Warner (1976). Sample extracts were concentrated to approximately 0.50 ml for gas chromatographic analyses. Analyses were performed on a Hewlett Packard gas chromatograph (GC) equipped with flame ionization detection. Separations were performed by using a 182-cm by 2-mm i.d. glass column packed with 3% OV101 on 100/120 mesh Supelcoport. Helium carrier gas was used at a flow of 30 mℓ/min.

Quality Assurance of Chemical Analyses

All standards used for quantitations of pesticides were obtained from EPA's repository in Las Vegas, Nevada. Standard solutions of metals were obtained from J.T. Baker Chemical Co., Phillipsburg, NJ, and were Instra-Analyzed quality. Dotriacontane was obtained from Alltech Associates, Deerfield, Illinois, and was used as an internal standard to quantitate petroleum hydrocarbons.

A part of our quality assurance procedures includes fortification of samples of organisms and sediments with selected chemicals to evaluate the entire analytical system during the period of time quantitative analyses of test organisms and sediments are performed. Separate samples were fortified with selected pesticides, petroleum hydrocarbons, and metals. Reagent and glassware blanks were analyzed to verify that the analytical system was not contaminated with chemical residues that could interfere with quantitations.

Statistical Analyses

Residue data were analyzed according to guidance in the Implementation manual (EPA/CE, 1977).

Calculations were performed to determine whether variance of data sets were homogeneous. Then analysis of variance (ANOVA) was used to compare mean tissue concentration in animals exposed to each dredged material sample. When the calculated F-value exceeded the tabulated value, the Student-Newman-Keuls multiple-range test was used to determine which dredged material mean was significantly different from the Reference mean. These analyses were performed using Statistical Analysis System (SAS) procedures (SAS Institute Inc.).

RESULTS AND DISCUSSION

Analyses of Pesticides and PCBs

During these analyses, only oysters, were available in sufficient numbers to allow them to be used for spiking. However, we believe the results of spiked samples (Table 1) indicate that the extraction and quantitation techniques were adequate for determining concentrations of chemical residues in organisms and sediments used in the bioaccumulation study. Results of reageant and glassware blank analyses verified that residues of pesticides, PCBs, petroleum hydrocarbons, metals, or other contaminants were not present prior to the analyses of test organisms and sediments.

Prior to the bioaccumulation test, chemical analyses were performed on samples of each group of organisms and sediments. Results (Table 2) indicate that residues of pesticides and PCBs were not present in concentrations above the detection limits. Residues of pesticides or PCBs were not detected in replicate samples of reference sediment from Sites 1, 2 or 3. Detection limits were the same as those in Table 2.

After organisms were exposed to a reference sediment or test sediments from Bayou la Batre, they were analyzed for pesticides, petroleum hydrocarbons, and metals. Results of chemical analyses for pesticides and PCBs that accumulated in organisms from exposure to reference sediment are shown in Table 3. Results of chemical analyses of organisms exposed to sediment from Sites 1, 2 and 3 are shown in Tables 4, 5 and 6 respectively. These results indicate that neither pesticides nor PCBs accumulated in tissues.

Analyses of Metals

Replicate samples of each group of organisms were analyzed for selected metals before and after a 10-day bioaccumulation test. Results from the pretest analyses are shown in Table 7 with method detection limit given for each element. Concentrations of some elements could not be quantitated because our instrument has some limitations and cannot correct for interferences from high concentrations of some elements present in these samples. Results in Table 8 show that all sediment samples contained some heavy metals. Less than concentrations are shown for mercury and lead, since accurate background correction was not possible with these elements.

Concentrations of selected metals in samples of oysters exposed for 10 days to a reference sediment or sediment samples from Sites 1, 2 and 3 in Bayou la Batre are shown in Table 9. Test for homogeneity of variances was performed on cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni), and zinc (Zn). Results in Tables 10 through 14 show that calculated C-values were greater than the tabulated C-values at the 95-percent confidence level for chromium and nickel; therefore the variances were not considered homogenous. However, except for nickel and zinc, means of all elemental concentrations in oysters exposed to sediment from Sites 1, 2 and 3 were similar to means of these elemental concentrations in oysters exposed to the reference sediment. Therefore, no further statistical analyses were performed. Analysis of varinace (ANOVA) of oyster bioaccumulation data for nickel and zinc shown in Tables 15 and 16. No significant differences were detected for nickel or zinc at the 0.050 alpha level.

Concentrations of metals in samples of lugworms exposed for 10 days to sediments from a reference site and separate sediment samples from Sites 1, 2 and 3 are shown in Table 17. Results of test for homogeneity of variance are shown in Tables 18 through 23. Because the means of elemental concentrations in tissues of lugworms exposed to sediment from Site 1, 2 or 3 were less than concentrations in a reference sediment for chromium, copper, and nickel, no further statistical analyses were performed.

Results from analyses of variance for selenium and zinc, in lugworms are shown in Tables 24 through 25. No significant differences were found at the 0.05 alpha level.

Concentrations of metals in samples of shrimp exposed for 10 days to sediment from a reference site or sediments from Sites 1, 2 or 3 are shown in Table 26. Results of test for homogeniety of variances performed on arsenic, chromium, copper, nickel and selenium, and zinc residues detected in shrimp tissues are shown in Tables 27 through 32. Because of similarity of means or because means from the sites were less than means for the reference sediment no further analyses were necessary for cadmium, and lead, mercury. Log transformation was necessary for copper, nickel and zinc data. Results from analysis of variance of arsenic, copper, nickel, selenium, and zinc data are shown in Tables 33 through 37, and indicate significant differences for Sites for bioaccumulation of Zn in tissues of shrimp. Student-Newman-Keuls multiple-range test was performed for zinc, Table 38 shows that mean values for shrimp exposed to sediment from Sites 1 and 2 were different from mean value for shrimp exposed to reference sediment.

Analyses of petroleum hycrocarbons

Concentrations of aliphatic and aromatic petroleum hydrocarbon analyses in tissues of organisms exposed to the reference sediment and sediment from Sites 1, 2 and 3 are shown in Table 39. Residues of aromatic (ARH) and aliphatic (ALH) hydrocarbons were detected in oysters; however, since mean concentrations shown in Table 40 for both aromatic and aliphatic petroleum hydrocarbons in oysters exposed to the reference sediments was greater than mean concentrations in animals exposed to sediments from sites, no further analyses were performed. Because mean concentrations shown in Table 41 for aromatic petroleum hydrocarbons in shrimp exposed to reference sediment were greater than in mean concentrations in shrimp exposed to sites, no further analyses were performed. Although mean concentrations for aliphatic petroleum hydrocarbons were differnt, Table 42 shows no significant differences when using analysis of variance. since mean concentraions shown in Table 43 of both aliphatic and aromatic petroleum hydrocarbons in tissues of lugworms exposed to sediment from sites were greater than those exposed to reference sediment, results of analysis of variance shown in Tables 44 and 45 show significant differences for aromatic hydrocarbons only. Further analysis using Student-Neuman-Keuls shown in Table 46, indicates significant differences for all sites compared to reference.

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Table 1. Percentage recovery of chlorinated hydrocarbon pesticides, and petroleum hydrocarbons spiked in tissues of organisms and reference sediment used in a bioaccumulation study. Method detection limit for each compound is given in µg/g wet tissue weight. Standard deviation is shown in parentheses.

Compound	Spike Concentration µg/g	N	Lugworm	N	Shrimp	N	Oyster	Sediment	Method Detection Limit µg/g
Aldrin	0.010	10	91 (7)	5	87 (11)	7	78 (10)	a	0.0020
BHC Isomers									
Alpha	0.0050		a		a		a	a	0.00080
Beta	0.010		a		a		a	a	0.0040
Gamma (lindane)	0.010	11	110 (9)	7	106 (8)	8	99 (8)	a	0.0020
Delta	0.020		a		a		a	a	0.0020
Chlordane	0.10		a		a		a	a	0.040
Chlorpyrifos (Dursban)	0.10	2	90 (3)	5	92 (4)	6	94 (12)	a	0.010
DDE	0.020	11	97 (8)	7	99 (10)	8	86 (9)	a	0.0040
DDD	0.040	12	100 (6)	7	97 (5)	8	95 (8)	a	0.0080
DDT	0.060	12	95 (7)	7	95 (8)	8	90 (10)	a	0.010
Dieldrin	0.020	11	95 (7)	7	95 (5)	8	97 (9)	a	0.0040
Endrin	0.020	9	100 (10)	7	98 (7)	8	99 (10)	a	0.010
Endosulfan I	0.020		a		a		a	a	0.010
Endosulfan II	0.020		a		a		a	a	0.010
Endosulfan Sulfate	0.10		a		a		a	a	0.050
Heptachlor	0.010	12	94 (6)	7	92 (6)	8	94 (4)	a	0.0020
Heptachlor epoxide	0.010	11	89 (3)	7	97 (8)	8	92 (12)	a	0.010
Hexachlorobenzene	0.050		a		a		a	a	0.0020
Methoxychlor	0.10	12	93 (7)	7	92 (5)	10	93 (8)	a	0.030
Mirex	0.10	11	88 (8)	7	91 (7)	10	71 (25)	a	0.020
PCBs	0.50		a		a		a	a	0.10
Toxaphene	1.0		a		a		a	a	0.20
Petroleum Hydrocarbons									
Aliphatic	1.0-5.0					8	90 (13)		0.50
Aromatic	1.0-1.5					8	87 (11)		0.50
Total									0.50

a Analytes were not spiked for recovery.

Table 2. Results of selected chlorinated pesticide and PCB analyses in replicate samples of three marine organisms analyzed piror to exposure to sediment from Bayou la Batre during a bioaccumulation study.

Common Name	Replicate	Lugworm 1	Lugworm 2	Shrimp 1	Shrimp 2	Oyster 1	Oyster 2
Aldrin		ND	ND	ND	ND	ND	ND
BHC Isomers		ND	ND	ND	ND	ND	ND
Alpha		ND	ND	ND	ND	ND	ND
Beta		ND	ND	ND	ND	ND	ND
Gamma (lindane)		ND	ND	ND	ND	ND	ND
Delta		ND	ND	ND	ND	ND	ND
Chlordane		ND	ND	ND	ND	ND	ND
Chlorpyrifos (Dursban)		ND	ND	ND	ND	ND	ND
DDE		ND	ND	ND	ND	ND	ND
DDD		ND	ND	ND	ND	ND	ND
DDT		ND	ND	ND	ND	ND	ND
Dieldrin		ND	ND	ND	ND	ND	ND
Endrin		ND	ND	ND	ND	ND	ND
Endosulfan I		ND	ND	ND	ND	ND	ND
Endosulfan II		ND	ND	ND	ND	ND	ND
Endosulfan Sulfate		ND	ND	ND	ND	ND	ND
Heptachlor		ND	ND	ND	ND	ND	ND
Heptachlor epoxide		ND	ND	ND	ND	ND	ND
Hexachlorobenzene		ND	ND	ND	ND	ND	ND
Methoxychlor		ND	ND	ND	ND	ND	ND
Mirex		ND	ND	ND	ND	ND	ND
PCBs		ND	ND	ND	ND	ND	ND
Toxaphene		ND	ND	ND	ND	ND	ND

ND = Not detected, see Table 1 for detection limits.

analyzed after 10 day exposure to a reference sediment during a bioaccumulation study with sediments from Bayou la Batre.

Common Name	Replicate	Lugworm					Shrimp					Oyster				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Aldrin		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BHC Isomers		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Alpha		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Beta		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Gamma (lindane)		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Delta		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlordane		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorpyrifos (Dursban)		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDE		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDD		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDT		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan II		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan Sulfate		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mirex		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = Not detected, see Table 1 for detection limits.

Table 4. Results of selected chlorinated pesticide and PCB residues in replicate samples of three marine organisms analyzed after 10 day exposure to sediment from Bayou la Batre - Site 1 during a bioconcentration study.

Common Name	Lugworm					Shrimp					Oyster				
Replicate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Aldrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BHC Isomers	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Alpha	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Beta	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Gamma (lindane)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Delta	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlordane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorpyrifos (Dursban)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDD	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan Sulfate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mirex	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = Not detected, see Table 1 for detection limits.

Common Name	Replicate	Lugworm 1	Lugworm 2	Lugworm 3	Lugworm 4	Lugworm 5	Shrimp 1	Shrimp 2	Shrimp 3	Shrimp 4	Shrimp 5	Oyster 1	Oyster 2	Oyster 3	Oyster 4	Oyster 5
Aldrin		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BHC Isomers		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Alpha		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Beta		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Gamma (lindane)		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Delta		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlordane		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorpyrifos (dursban)		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDE		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDD		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDT		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan II		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan Sulfate		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mirex		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = Not detected, See Table 1 for detection limits.

Table 7. Concentrations of selected metals in tissues of organisms that were determined as background residues before the organisms were used in the Bayou la Batre study. Method detection limits for each element is given in μg/g wet tissue weight.

Pre-Test Organism	Replicate	Concentrations in μg/g wet tissue weight								
		As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Shrimp	1	6.3	0.23	1.4	13	ND	0.65	2.5	3.0	27
	2	5.6	ND	0.56	12	ND	1.0	ND	2.4	14
Lugworm	1	4.9	ND	1.1	2.1	ND	0.38	3.5	2.5	7.0
	NA									
Oyster	1	ND	0.375	0.800	8.4	ND	0.35	ND	ND	190
	2	ND	0.375	1.3	9.7	1.1	0.725	ND	ND	190
		Method Detection Limits								
		[a] 0.375	0.1250	0.25	0.15	0.625	0.25	0.50	0.375	0.125

NA = Not analyzed: insufficient numbers of animals for a second replicate analysis.

[a] Based on final vol of 50 mℓ and a sample weight of 2g (maximum sample size).

ND = Not detected.

Table 8. Concentrations of selected metals in sediment samples from a reference site and three sites from Bayou la Batre.

Sediment Location	Replicate	Concentrations in μg/g wet weight								
		As	Cd	Cr	Cu	< Hg[b]	Ni	< Pb[b]	Se	Zn
Reference		a	ND	26	11	a	11	47	a	12
Site 1	D	38	0.27	5.6	26	7.8	2.6	25	a	78
Site 2	D	75	0.45	10	3.2	12	5.4	34	a	41
Site 3	C	ND	0.52	12	3.8	14	6.1	37	a	41

[a] Interference from other metals prevented accurate quantitation.

ND = not detected, see Table 7 for detection limits.

[b] Background subtraction techniques normally used could not be applied due to interference from unknown elements causing background to be unusually intense. Therefore, mercury and lead values are reported as maximum poss concentrations.

Table 9. Concentrations of selected metals in samples of oysters used in a bioaccumulation study with sediments from three sites within Bayou la Batre and a reference site.

Sediment Location	Replicate	Concentrations in µg/g wet tissue weight								
		As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Site 1	1	ND	0.275	0.400	6.2	ND	0.55	ND	ND	185
	2	ND	0.225	0.625	3.8	ND	0.65	ND	ND	185
	3	ND	0.250	0.650	6.0	ND	1.5	ND	ND	235
	4	ND	0.325	0.550	4.7	ND	0.625	ND	ND	188
	5	ND	0.500	0.675	10	ND	0.525	0.975	ND	475
Site 2	1	ND	0.375	0.500	6.1	ND	0.45	ND	ND	250
	2	ND	0.325	0.550	3.4	ND	0.70	ND	ND	120
	3	ND	0.350	0.500	6.6	ND	0.60	ND	ND	210
	4	ND	0.350	0.425	5.4	ND	0.50	ND	ND	160
	5	ND	0.575	0.600	9.4	0.70	2.0	ND	ND	300
Site 3	1	NA								
	2	ND	0.475	0.400	5.6	ND	0.35	ND	ND	180
	3	ND	0.450	0.800	7.5	ND	0.425	ND	ND	250
	4	ND	0.325	0.400	2.7	ND	0.325	ND	ND	140
	5	ND	0.300	0.875	6.2	ND	0.625	ND	ND	210
Reference	1	ND	0.45	0.900	9.0	ND	0.525	0.60	ND	200
	2	ND	0.575	1.5	8.3	ND	0.700	2.0	ND	320
	3	ND	0.450	1.2	11.0	ND	0.675	1.0	ND	310
	4	ND	0.275	0.45	4.0	ND	0.325	ND	ND	140
	5	ND	0.275	1.1	7.0	ND	0.750	ND	ND	180

ND = not detected.

NA = not available for analysis due to insufficient number of animals.

Table 10. Statistical analysis of cadmium (μg/g wet tissue) in samples of oysters used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	2	3
1	0.45	0.275	0.375	NA
2	0.575	0.225	0.325	0.475
3	0.450	0.250	0.350	0.450
4	0.275	0.325	0.350	0.325
5	0.275	0.500	0.575	0.300
Sum of data, Σx =	2.025	1.575	1.975	1.55
Mean $\bar{X}$ =	0.405	0.315	0.395	0.387!
Sum of squared data, Σx^2 =	0.886	0.544	0.821	0.623
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$	0.0667	0.0482	0.0417	0.0231
Variance	0.0166	0.0120	0.010	0.0077

$C = \frac{0.0077}{0.046} = 0.167$ $\quad C = \frac{s^2(max)}{\sum_{i=1}^{4} s^2i}$ Where s^2i is estimate of variance of i^{th} si

Chi square (4,4) = 0.6287

Since calculated C is less than tabulated Chi square, variances are homogeneous transformation is unnecessary.

Since means for Sites are less than reference mean, further analysis is necessar

NA = Sample not available for anlaysis.

Table 11. Statistical analysis of chromium (μg/g wet tissue) in samples of oysters used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	2	3
1	0.900	0.400	0.500	NA
2	1.5	0.625	0.550	0.400
3	1.2	0.650	0.500	0.800
4	0.45	0.550	0.425	0.400
5	1.1	0.625	0.600	0.875
Sum of data, Σx =	5.15	2.85	2.575	2.475
Mean $\bar{X}$ =	1.03	0.57	0.515	0.618
Sum of squared data, Σx^2 =	5.91	1.666	1.343	1.725
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$	0.608	0.041	0.017	0.19
Variance	0.152	0.010	0.0042	0.0647

$C = \frac{0.152}{0.23} = 0.66$ $\quad C = \frac{s^2(max)}{\sum_{i=1}^{4} s^2 i}$ Where $s^2 i$ is estimate of variance of i^{th} site.

Chi square (4,4) = 0.6287

Since calculated C is greater than tabulated Chi square, variances are not homogeneous, use log transformation.

Since means for Sites are less than reference mean, no further analyses necessary.

NA = Sample not available for analysis.

Table 12. Statistical analysis of copper (μg/g wet tissue) in samples of oysters used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	2	3
1	9.0	6.2	6.1	NA
2	8.3	3.8	3.4	5.6
3	11.	6.0	6.6	7.5
4	4.0	4.7	5.4	2.7
5	7.0	10	9.4	6.2
Sum of data, Σx =	39.3	30.7	30.9	22
Mean $\bar{X}$ =	7.86	6.14	6.18	5.5
Sum of squared data, Σx^2 =	335	210	209	133
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$	26.9	22.4	18.8	12.3
Variance =	6.74	5.61	4.72	4.11

The means for sites are smaller than mean for reference. No further analysis is necessary.

NA = Sample not avialable for analysis.

Table 13. Statistical analysis of nickel (μg/g wet tissue) in samples of oysters used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	2	3
1	0.525	0.55	0.45	NA
2	0.700	0.65	0.70	0.35
3	0.675	1.5	0.60	0.425
4	0.325	0.625	0.50	0.325
5	0.750	0.525	2.0	0.625
Sum of data, Σx =	2.975	3.85	4.25	1.725
Mean $\overline{X}$ =	0.595	0.770	0.850	0.031
Sum of aquared data,				
Σx^2 =	1.88	3.64	5.30	0.799
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$	0.119	0.676	1.69	0.0554
Variance =	0.029	0.169	0.422	0.0184

C = 0.422/.638 = 0.66

Chi square (4,4) = 0.6287

Since calculated C is greater than tabulated Chi square, variances are not homogeneous and transformation is necessary.

Table 14. Statistical analysis of zinc (μg/g wet tissue) in samples of oysters used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	Sites 2	Sites 3
1	200	185	250	NA
2	320	185	120	180
3	310	235	210	250
4	140	188	16C	140
5	180	475	300	210
Sum of data, Σx =	1160	1268	1040	780
Mean, $\overline{X}$ =	232	253	208	195
Sum of squared data, Σx^2 =	294200	384644	236600	158600
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	25080	63079	20280	6500
Variance =	6270	15769	5070	2166

C = 15769/29275 = .53

Chi square (4,4) = 0.6287

Since calculated C is less than tabulated Chi square, variances are homogeneous an transformation is unnecessary.

NA = Sample not available for analysis.

Table 15. Analysis of variance of nickel accumulation in oysters in the Bayou la Batre study using log transformation.

Analysis of Variance Procedure

Dependent Variable: Weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.0249	0.00831	1.10	0.381
Error	15	0.1138	0.00759		
Corrected Total	18	0.1388			
		C.V.	Root MSE		WEIGHT Mean
		40.68	0.0871		0.214

Table 16. Analysis of variance of zinc accumulation in oysters used in the Bayou la Batre study.

Analysis of Variance Procedure

Dependent Variable: Weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	9341	3113	0.41	0.75
Error	15	114939	7662		
Corrected Total	18	124280			

C.V.	Root MSE	WEIGHT Mean
39.152	87.531	223

Table 17. Concentrations of selected metals in samples of lugworms used in a bioaccumulation study with sediments from three sites within Bayou la Batre and a reference site.

Sediment Location	Replicate	Concentrations in µg/g wet tissue weight								
		As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Site 1	1	5.1	ND	0.83	1.6	ND	0.54	2.4	2.6	13
	2	5.9	ND	0.99	2.7	ND	0.50	ND	3.0	17
	3	6.1	ND	0.940	3.2	ND	0.41	ND	3.1	13
	4	NA	NA	NA	NA	NA	NA	NA	NA	NA
	5	4.6	ND	1.1	3.4	ND	0.54	ND	2.4	10
Site 2	1	7.0	ND	1.1	4.6	ND	0.90	ND	3.5	17
	2	4.6	ND	0.81	6.0	ND	0.47	ND	2.4	9.6
	3	7.3	ND	2.8	5.0	ND	2.0	ND	4.3	15
	4	5.5	ND	1.0	3.0	ND	0.61	1.2	2.6	13
	5	6.1	ND	0.93	2.3	ND	0.62	2.2	3.2	15
Site 3	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	4.7	ND	1.0	1.7	ND	0.40	ND	2.1	14
	3	5.5	ND	1.4	3.2	ND	1.1	ND	2.0	9.4
	4	5.3	ND	1.4	2.5	ND	0.66	ND	2.6	15
	5	5.7	ND	0.81	2.2	ND	0.36	ND	2.7	13
Reference	1	4.7	ND	2.2	5.2	ND	1.5	ND	2.6	9.8
	2	5.7	ND	1.8	6.3	ND	1.3	ND	2.7	13
	3	5.0	ND	5.3	10	ND	3.8	ND	2.5	11
	4	4.4	ND	1.8	5.0	ND	0.99	ND	2.3	10
	5	4.9	ND	0.65	1.4	ND	1.0	ND	2.5	12

ND = not detected.

NA = not available for analysis due to insufficient number of animals.

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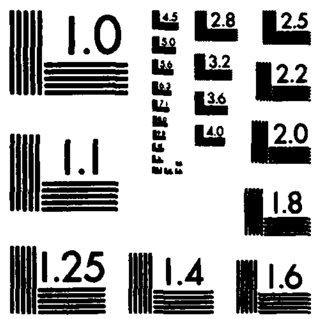

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Table 18. Statistical analysis of arsenic (µg/g wet tissue) in samples of lugworms used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	2	3
1	4.7	5.1	7.0	NA
2	5.7	5.9	4.6	4.7
3	5.0	6.1	7.3	5.5
4	4.4	NA	5.5	5.3
5	4.9	4.6	6.1	5.7
Sum of data, Σx =	24.7	21.7	30.5	21.2
Mean $\bar{X}$ =	4.94	5.42	6.1	5.3
Sum of squared data,				
Σx^2 =	1.22	119	190	112
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$	0.932	1.4	4.8	0.56
Variance =	0.233	0.489	1.21	0.187

NA = Sample not available for analysis.

C = 1.21/2.11 = 0.57

Chi square (4.4) = 0.6287

Since calculated C is less than tabulated chi square, variances are homogenous and transformation is unnecessary.

Table 19. Statistical analysis of chromium (μg/g wet tissue) in samples of lugworms used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	Sites 2	Sites 3
1	2.2	0.83	1.1	NA
2	1.8	0.99	0.81	1.0
3	5.3	0.94	2.8	1.4
4	1.8	NA	1.0	1.4
5	0.65	1.1	0.93	0.81
Sum of data, Σx =	11.75	3.86	6.64	4.61
Mean $\bar{X}$ =	2.35	0.965	1.328	1.153
Sum of squared data,				
Σx^2 =	39.8	3.76	11.57	5.57
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$	12.2	0.038	2.75	0.263
Variance =	3.05	0.013	0.68	0.088

$C = \frac{3.05}{3.83} = 0.79$

Chi square (4.4) = 0.6287

Since calculated C is greater than tabulated Chi square, variances are ~~not~~ homogenous and transformation is necessary. Since means for sites were less than mean for reference, no further analysis necessary.

NA = Sample not available for analysis.

Table 20. Statistical analysis of copper (μg/g wet tissue) in samples of lugworms used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	2	3
1	5.2	1.6	4.6	NA
2	6.3	2.7	6.0	1.7
3	10	3.1	5.0	3.2
4	5.0	NA	3.0	2.5
5	1.4	3.4	2.3	2.2
Sum of data, Σx =	27.9	10.9	20.9	9.6
Mean $\overline{X}$ =	5.58	2.72	4.18	2.4
Sum of squared data, Σx^2 =	193. 7	31.6	96.4	24.2
$CSS = \Sigma x^2 - \frac{(\Sigma X)^2}{n}$	38.0	1.94	9.0	1.18
Variance =	9.5	0.64	2.2	0.39

Means for sites were less than mean for reference, therefore no further analysis necessary.

NA = Sample not available for analysis.

Table 21. Statistical analysis of nickel (μg/g wet tissue) in samples of lugworms used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	Sites 2	Sites 3
1	1.5	0.54	0.90	NA
2	1.3	0.50	0.47	0.40
3	3.8	0.41	2.0	1.1
4	0.99	NA	0.61	0.66
5	1.0	0.54	0.62	0.36
Sum of data, Σx =	8.59	1.99	4.60	2.52
Mean $\bar{X}$ =	1.71	0.498	0.920	0.630
Sum of squared data, Σx^2 =	20.3	1.00	5.78	1.93
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$	5.60	0.011	1.55	0.348
Variance =	1.40	0.004	0.389	0.116

$C = \frac{1.4}{1.90} = 0.73$

Chi square (4,4) = 0.6287

Since calculated C is greater than tabulated Chi square, variances are ~~not~~ homogeneous and transformation is necessary. Since means for Sites were less than reference mean, no further analysis necessary.

NA = Sample not available for analysis.

Table 22. Statistical analysis of selenium (μg/g wet tissue) in samples of lugworms used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	Sites 2	Sites 3
1	2.6	2.6	3.5	NA
2	2.7	3.0	2.4	2.1
3	2.5	3.1	4.3	2.0
4	2.3	NA	2.1	2.6
5	2.5	2.4	3.2	2.7
Sum of data, Σx =	12.6	11.1	16.0	9.4
Mean $\overline{X}$ =	2.5	2.77	3.20	2.35
Sum of squared data, Σx^2 =	31.8	31.1	52.5	22.4
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$	0.088	0.328	2.3	0.37
Variance =	0.022	0.109	0.575	0.123

$C = \frac{0.575}{0.829} = 0.69$

Chi square (4,4) = 0.6287

Since calculated C is greater than tabulated Chi square, variances are ~~not~~ homogeneous and transformation is necessary.

NA = Sample not available for analysis.

Table 23. Statistical analysis of zinc (μg/g wet tissue) in samples of lugworms used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	2	3
1	9.8	13	17	Na
2	13	17	9.6	14
3	11	13	15	9.4
4	10	NA	13	15
5	12	10	15	13
Sum of data, Σx =	55.8	53.0	69.6	51.4
Mean $\bar{X}$ =	11.1	13.2	13.9	12.8
Sum of squared data,				
Σx^2 =	630	727	1000	678
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$	7.31	24.7	31.3	17.8
Variance =	1.82	8.25	7.83	5.95

$C = \frac{8.25}{23.85} = 0.345$

Chi square (4,4) = 0.6287

Since calculated C is less than tabulated Chi square, variances are not homogeneous.

NA = Sample not available for analysis.

Table 24. Analysis of variance of selenium accumulation in lugworms used in the Bayou la Batre study.

Analysis of Variance Procedure

Dependent Variable: Weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.02296	0.007654	2.99	0.0671
Error	14	0.03587	0.002562		
Corrected Total	17	0.05883			
		C.V.	Root MSE		WEIGHT Mean
		8.919	0.05062		0.5675

Table 25. Analysis of variance of zinc accumulation in lugworms used in the Bayou la Batre study.

Analysis of Variance Procedure

Dependent Variable: Weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	20.5200	6.8400	1.18	0.3533
Error	14	81.26000	5.8042		
Corrected Total	17	101.7800			

C.V.	Root MSE	WEIGHT Mean
18.8711	2.4092	12.766

Table 26. Concentrations of selected metals in samples of shrimp used in a bioaccumulation study with sediments from three sites within Bayou la Batre and a reference site.

Sediment Location	Replicate	Concentrations in µg/g wet tissue weight								
		[b]As	Cd	Cr	Cu	Hg	Ni	[b]Pb	[b]Se	Zn
Site 1	1	6.0	ND	0.74	19	1.9	1.1	0.79	3.1	15
	2	5.7	ND	0.80	6.5	0.78	0.78	ND	3.4	11
	3	8.4	ND	0.52	7.6	ND	0.45	ND	3.4	14
	4	7.2	ND	0.50	13	ND	0.30	0.50	4.0	11
	5	9.7	ND	0.72	19	ND	0.35	ND	3.7	14
Site 2	1	9.4	ND	0.38	14	ND	0.31	ND	4.6	15
	2	7.2	ND	0.66	11	ND	0.50	0.53	3.7	14
	3	7.4	ND	0.48	9.8	ND	0.55	ND	3.2	12
	4	9.8	ND	0.50	9.4	ND	0.43	0.48	3.8	11
	5									
Site 3	1	9.5	ND	0.68	8.9	ND	0.54	ND	4.6	11
	2	7.1	ND	0.50	7.4	ND	0.44	ND	3.3	9.2
	3	9.8	ND	0.44	10	ND	0.47	ND	4.6	11
	4	8.8	ND	0.53	11	ND	0.34	ND	4.7	9.5
	5	7.8	ND	0.34	11	ND	ND	0.82	4.1	9.1
Reference	1	8.9	ND	1.4	17	ND	0.53	ND	3.9	12
	2	10	ND	0.42	10	ND	0.21	ND	5.2	9.6
	3	8.1	ND	0.95	11	ND	0.45	ND	3.4	9.8
	4	7.4	ND	0.60	8.1	ND	0.33	ND	3.6	9.5
	5	6.6	ND	0.26	9.5	ND	ND	ND	3.1	9.0

ND = not detected.

[b] Concentrations are given as the maximum amount.

Table 27. Statistical analysis of arsenic (µg/g wet tissue) in samples of shrimp used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	2	3
1	8.9	6.0	9.4	9.5
2	10	5.7	7.2	7.1
3	8.1	8.4	7.4	9.8
4	7.4	7.2	9.8	8.8
5	6.6	9.7	6.6	7.8
Sum of data, Σx =	41.0	37.0	40.4	43.0
Mean, $\bar{X}$ =	8.2C0	7.400	8.08	8.60
Sum of squared data, Σx^2 =	343.1	284.9	334.5	374.9
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	6.94	11.18	8.12	5.18
Variance =	1.73	2.79	2.03	1.29

$C = \frac{2.79}{7.84} = 0.35$

Chi square (4,4) = 0.6287

Since calculated C is less than tabulated Chi square, variances are homogeneous and transformation is unnecessary.

Table 28. Statistical analysis of chromium ($\mu g/g$ wet tissue) in samples of shrimp used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	2	3
1	1.4	0.74	0.38	0.68
2	0.42	0.80	0.66	0.50
3	0.95	0.52	0.48	0.44
4	0.60	0.50	0.50	0.53
5	0.26	0.72	0.75	0.34
Sum of data, Σx =	3.63	3.28	2.77	2.49
Mean, $\bar{X}$ =	0.726	0.656	0.554	0.498
Sum of squared data, Σx^2 =	3.26	2.22	1.62	1.30
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	0.831	0.075	0.088	0.062
Variance =	0.208	0.019	0.022	0.016

Means for sites were smaller than mean for reference, no further analysis is necessary.

Table 29. Statistical analysis of copper (μg/g wet tissue) in samples of shrimp used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	2	3
1	17	19	14	8.9
2	10	6.5	11	7.4
3	11	7.6	9.8	10
4	8.1	13	9.4	11
5	9.5	19	13	11
Sum of data, Σx =	55.6	65.1	57.2	48.3
Mean, $\bar{X}$ =	11.1	13.0	11.4	9.66
Sum of squared data, Σx^2 =	665.8	991.0	670.4	475.9
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	47.5	14.4	16.03	9.39
Variance =	11.89	35.85	4.00	2.34

$C = \frac{35.85}{54.08} = 0.66$

Chi square (4,4) = 0.6287

Since calculated C is greater then tabulated Chi square, use log transformation.

Table 30. Statistical analysis of nickel (μg/g wet tissue) in samples of shrimp used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	2	3
1	0.53	1.1	0.31	0.54
2	0.21	0.78	0.50	0.44
3	0.45	0.45	0.55	0.47
4	0.33	0.35	0.43	0.34
5				
Sum of data, Σx =	1.52	2.98	2.18	1.79
Mean, $\bar{X}$ =	0.38	0.596	0.436	0.448
Sum of squared data, Σx^2 =	0.636	2.233	0.986	0.822
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	0.059	0.457	0.035	0.021
Variance =	0.020	0.114	0.009	0.007

$C = \frac{0.114}{0.15} = 0.76$

Chi square (4,4) = 0.6287

Since calculated C is greater then tabulated Chi square, variances are ~~not~~ homogenous and transformation is necessary.

ND = Not detected.

Table 31. Statistical analysis of selenium (μg/g wet tissue) in samples of shrimp used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	2	3
1	3.9	3.2	4.6	4.6
2	5.2	3.4	3.7	3.3
3	3.4	3.4	3.2	4.6
4	3.6	4.0	3.9	4.7
5	3.1	3.7	3.8	4.1
Sum of data, Σx =	19.2	17.7	19.2	21.3
Mean, $\bar{X}$ =	3.84	3.54	3.84	4.26
Sum of squared data, Σx^2 =	76.3	63.0	74.7	92.1
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	2.65	0.39	1.01	1.37
Variance =	0.66	0.098	0.25	0.34

$C = \frac{0.66}{1.34} = 0.49$

Chi square (4,4) = 0.6287

Since calculated C is less then tabulated Chi square, variances are homogenous and transformation is unnecessary.

Table 32. Statistical analysis of zinc (µg/g wet tissue) in samples of shrimp used in the Bayou la Batre study.

Replicate (n = 5)	Reference	Sites 1	2	3
1	12	15	15	11
2	9.6	11	14	9.2
3	9.8	14	12	11
4	9.5	11	12	9.5
5	9.0	14	11	9.1
Sum of data, Σx =	47.9	65.0	64.0	49.8
Mean, $\bar{X}$ =	9.98	13.0	12.8	9.96
Sum of squared data, Σx^2 =	503.4	859.0	830.0	499.7
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	5.44	14.0	10.8	3.69
Variance =	1.36	3.5	2.7	0.92

$C = \frac{3.5}{8.48} = 0.41$

Chi square (4,4) = 0.6287

Since calculated C is less then tabulated Chi square, variances are homogenous and transformation is unnecessary.

Table 33. Analysis of variance of arsenic accumulation in shrimp used in the Bayou la Batre study.

Analysis of Variance Procedure

Dependent Variable: Weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	3.7340	1.2446	0.63	0.604
Error	14	31.4280	1.9642		
Corrected Total	17	35.1620			
		C.V	Root MSE		WEIGHT Mean
		17.367	1.4015		8.070

Table 34. Analysis of variance of copper accumulation in shrimp used in the Bayou la Batre study.

Analysis of Variance Procedure

Dependent Variable: Weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.02096	0.0069867	0.45	0.718
Error	14	0.24653	0.015408		
Corrected Total	17	0.26749			

C.V	Root MSE	WEIGHT Mean
11.55	0.12413	1.074

Table 35. Analysis of variance of nickel accumulation in shrimp used in the Bayou la Batre study.

Analysis of Variance Procedure

Dependent Variable: Weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.008028	0.002676	0.89	0.472
Error	14	0.04225	0.0030184		
Corrected Total	17	0.050286			

C.V	Root MSE	WEIGHT Mean
33.485	0.05494	0.16407

Table 36. Analysis of variance of selenium accumulation in shrimp used in the Bayou la Batre study.

Analysis of Variance Procedure

Dependent Variable: Weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1.3140	0.4380	1.29	0.311
Error	14	5.42805	6.3392184		
Corrected Total	17	6.7420			
		C.V	Root MSE		WEIGHT Mean
		15.05	0.5824		3.870

Table 37. Analysis of variance of selenium accumulation in shrimp used in the Bayou la Batre study.

Analysis of Variance Procedure

Dependent Variable: Weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.05164	0.01721	7.28	0.0027
Error	14	0.03785	0.002365		
Corrected Total	17	0.08950			
		C.V	Root MSE		WEIGHT Mean
		4.4648	0.04864		1.0894

Table 38. Comparison of zinc bioaccumulation in samples of shrimp from Bayou la Batre sites sith shrimp from reference sediments.

$$S_{\bar{x}} = \sqrt{\frac{MSE}{n}} = \sqrt{\frac{0.002365}{5}} = 0.02175$$

At the alpha = 0.05 level,

	K	
	2	3
Q	3.00	3.65
$S_{\bar{x}}$	0.02175	0.02175
LSR = $QS_{\bar{x}}$	0.176	0.214

Treatment means from computer printout

Site 3	Ref	Site 2	Site 1
9.96	9.98	12.8	13

Mean Comparison

K	LSR	Difference between means
2	0.176	Site 2-Ref = 12.8 - 9.98 = 2.82*
2	0.214	Site 1-Ref = 13.0 - 9.98 = 3.02*

Note: * indicates significant difference at alphı = 0.05

Table 39. Concentrations of aliphatic and aromatic fractions of petroleum hydrocarbons in replicate samples of three marine organisms. Each group of organisms was anlayzed and after exposure to sediment from Bayou la Batre in a bioaccumulation study. Concentrations are given in ug/g wet tissue.

Sample Origin	Shrimp					Lugworm					Oyster					Pre-test Sediment	
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2
Pre-test Animals																	
Aliphatic	ND	NA	NA	NA	NA	ND	NA	NA	NA	NA	5.0	NA	NA	NA	NA		
Aromatic	ND	NA	NA	NA	NA	41	NA	NA	NA	NA	ND	NA	NA	NA	NA		
Site 1																	
Aliphatic	12.3	2.61	2.90	ND	ND	12.3	14.0	15.1	17.1	16.1	ND	6.04	2.40	3.20	ND	219	562
Aromatic	5.02	0.972	ND	3.1	ND	30.6	29.7	37.1	38.4	33.2	3.25	6.06	1.89	11.3	1.76	ND	ND
Site 2																	
Aliphatic	ND	ND	ND	ND	ND	17.6	6.37	7.21	4.23	3.38	4.35	0.896	0.870	8.20	ND	154	15[illegible]
Aromatic	ND	ND	ND	ND	ND	23.9	19.3	22.0	15.8	15.6	ND	0.430	ND	ND	ND	ND	ND
Site 3																	
Aliphatic	ND	9.38	2.49	0.536	1.33	0.556	ND	28.3	11.4	8.47	ND	0.873	5.89	10.8	2.31	31	3[illegible]
Aromatic	1.87	2.49	4.44	2.44	7.80	11.6	7.65	15.5	9.71	22.2	ND	ND	ND	ND	1.58	ND	N[illegible]
Reference																	
Aliphatic	0.707	ND	8.57	1.47	0.849	4.93	8.43	1.72	10.65	7.77	4.17	6.10	3.44	5.9	11.0		
Aromatic	4.83	7.20	6.49	7.94	7.30	ND	2.27	4.98	ND	2.85	1.27	1.48	1.16	13.1	16.1		

ND = Not detected

NA = Sample not available for analyses.

Table 40. Statistical analysis of petroleum hydrocarbons (μg/g wet tissues) in oysters used in Bayou la Batre Study.

Replicate	Reference		Sites					
			1		2		3	
	ALH	ARH	ALH	ARH	ALH	ARH	ALH	ARH
1	4.17	1.27	ND	3.25	4.35	ND	ND	ND
2	6.10	1.47	6.04	6.06	0.896	0.430	0.873	ND
3	3.44	1.16	2.40	1.89	0.870	ND	5.89	ND
4	5.90	13.1	3.20	11.3	8.20	ND	10.8	ND
5	11.0	16.1	ND	1.76	ND	ND	2.31	1.58
Sum, Σx =	30.61	33.10	11.64	24.26	14.31	0.4300	19.87	1.580
Mean $\bar{X}$ =	6.122	6.620	3.880	4.850	3.579	0.4300	4.968	1.580
Sum of squared data,								
Σx^2=	222.2	435.9	52.48	181.6	87.72	0.1849	157.4	2.496
CSS =	34.84	216.8	7.318	63.93	36.48	0	58.69	0
Variance =	8.712	54.20	3.659	15.98	12.16	.	19.56	.

ND = Not detected.

C (ALH) = 19.56/44.09 = 0.4436 Chi square (4, 4) = 0.6284

Since calculated C is less than tabulated chi square, variances are homogenous and transformation not necessary.

C (ARH) = 54.20/70.18 = 0.772 Chi square (4, 4) = 0.6284

Since calculated C is greater than tabulated Chi square, variances are not homogenous and transformation is necessary.

Since means for sites are less than mean for reference, no further analyses necessary.

Table 41. Statistical analysis of petroleum hydrocarbons ($\mu g/g$ wet tissues) in shrimp used in Bayou la Batre Study.

Replicate	Reference		Sites					
			1		2		3	
	ALH	ARH	ALH	ARH	ALH	ARH	ALH	ARH
1	0.707	4.83	12.3	5.02	ND	ND	ND	1.87
2	ND	7.20	2.61	0.970	ND	ND	9.37	2.24
3	8.57	6.49	2.90	ND	ND	ND	2.49	4.44
4	1.47	7.94	ND	3.13	ND	ND	0.536	2.44
5	0.849	7.30	ND	ND	ND	ND	1.33	7.80
Sum, Σx =	11.59	33.76	17.81	9.122	ND	ND	13.72	18.79
Mean $\bar{X}$ =	2.899	6.752	5.936	3.040	ND	ND	3.431	3.758
Sum of squared data,								
Σx^2 =	76.82	233.6	166.5	35.94	ND	ND	96.05	95.02
CSS =	43.20	5.675	60.78	8.205	ND	ND	48.95	24.40
Variance =	14.40	1.418	30.39	4.102	ND	ND	16.31	6.102

ND = Not detected.

C (ALH) = 30.39/61.10 = 0.497 Chi square (4, 4) = 0.6287

Since calculated C is less than tabulated chi square, variances are homogenous and transformation not necessary.

C (ARH) = 4.102/11.62 = 0.353, Chi square (4, 4) = 0.6287

Since calculated C is less than tabulated Chi square, variances are homogenous and transformation is unnecessary.

Since means for sites are less than mean for reference, no further analyses necessary for ARH (aromatic petroleum hydrocarbons).

Table 42. Analysis of variance of aliphatic petroleum hydrocarbon accumulation in shrimp used in the Bayou la Batre study.

Analysis of Variance Procedure

Dependent Variable: Weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	17.3251	8.662	0.45	0.651
Error	8	152.942	19.117		
Corrected Total	10	170.267			
		C.V	Root MSE		WEIGHT Mean
		111.50	4.372		3.9210

Table 43. Statistical analysis of petroleum hydrocarbons (µg/g wet tissues) in lugworms used in Bayou la Batre Study.

Replicate	Reference		Sites					
			1		2		3	
	ALH	ARH	ALH	ARH	ALH	ARH	ALH	ARH
1	4.93	ND	12.3	30.6	17.6	23.9	0.556	11.6
2	8.43	2.27	14.0	29.7	6.37	19.3	ND	7.65
3	1.72	4.98	15.1	37.1	7.27	22.0	28.3	15.5
4	10.6	ND	17.1	38.4	4.23	15.8	11.4	9.71
5	7.77	2.85	16.1	33.2	3.38	15.6	8.47	22.2
Sum, Σx =	33.45	10.10	74.6	169	38.8	96.6	48.7	66.6
Mean $\bar{X}$ =	6.69	3.36	14.9	33.8	7.77	19.32	12.18	13.3
Sum of squared data,								
Σx^2=	271.0	38.07	1126.9	5771.6	432.50	1920.7	1002.9	1020.4
CSS =	47.28	4.072	13.88	59.465	130.6	54.38	409.3	131.7
Variance =	11.82	2.036	3.472	14.86	32.66	13.59	136.4	32.93

ND = Not detected.

C (ALH) = 136.4/184.3 = 0.7401 Chi square (4, 4) = 0.6284

Since calculated C is greater than tabulated chi square, variances are not homogenous, use log transformation.

C (ARH) = 32.93/63.41 = 0.5193, Chi square (4, 4) = 0.6284

Since calculated C is less than tabulated Chi square, variances are homogenous and transformation is unnecessary.

Table 44. Analysis of variance of aliphatic petroleum hydrocarbon accumulation in lugworms used in the Bayou la Batre study.

Analysis of Variance Procedure

Dependent Variable: Weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.39369	0.13123	1.45	0.2677
Error	15	1.3566	0.09044		
Corrected Total	18	1.7503			

C.V	Root MSE	WEIGHT Mean
31.172	0.30073	0.9647

Table 45. Analysis of variance of aromatic petroleum hydrocarbon accumulation in lugworms used in the Bayou la Batre study.

Analysis of Variance Procedure

Dependent Variable: Weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1989.53	663.179	37.19	0.0001
Error	14	249.66	17.833		
Corrected Total	17	2239.20			

C.V	Root MSE	WEIGHT Mean
22.202	4.222	19.0200

Table 46. Comparison of aromatic petroleum hydrocarbon residues that bioaccumulated in lugworms used in the Bayou la Batre study.

$$S_{\bar{x}} = \frac{MSE}{n} = \frac{17.833}{5} = 0.02175$$

At the alpha = 0.05 level,

	K 2	K 3	K 4
Q	3.00	3.65	4.05
$S_{\bar{x}}$	1.88	1.88	1.88
$LSR = QS_{\bar{x}}$	5.64	12.50	7.61

Treatment means from computer printout

Ref	Site 3	Site 2	Site 1
3.36	13.3	19.3	33.8

Mean Comparison

K	LSR	Difference between means
2	5.64	Site 3-Ref = 13.3 - 3.36 = 9.94*
3	12.5	Site 2-Ref = 19.3 - 3.36 = 15.9*
4	7.61	Site 1-Ref = 33.8 - 3.36 = 3.04*

* indicates significant difference at alpha = 0.05

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ENVIRONMENTAL RESEARCH LABORATORY
SABINE ISLAND
GULF BREEZE FLORIDA 32561 3999

March 7, 1988

Ms. Susan Ivester Rees, PD-EC
U.S. Army Corps of Engineers
Mobile District
109 St. Joseph Street
Mobile, AL 36628-0001

Dear Susan:

Enclosed is the draft final report on the biological and chemical tests that we conducted with Bayou la Batre, AL, dredged material. Please review the reports and call me with any corrections or questions. If I don't hear from you in a few weeks, I will issue the final report.

Sincerely,

R.P. Parrish
Research Aquatic Biologist

Enclosure

cc: Wilhour
Mayer

SECTION D-6

DRAFT FISH AND WILDLIFE

COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE

P.O. Drawer 1190
Daphne, Al 36526

September 14, 1988

District Engineer
U.S. Army Corps of Engineers
P.O. Box 2288
Mobile, AL 36628

Dear Sir:

In accordance with the Letter of Agreement between our agencies for the Fiscal Year 1988, the Fish and Wildlife Service has completed this final report for the Bayou La Batre Channel Improvement Project, Alabama. Our report is submitted under provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. et seq.), the National Environmental Policy Act (42 U.S.C. 4321-4347), and the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) and is to be used in your determination of 404(b)(1) guidelines compliance (40 CFR 230) and in your public interest review (33 CFR 320.4) as it relates to protection of fish and wildlife resources.

The Bayou La Batre area is dependent on the seafood industry and, therefore, relies on both the continued utility of the harbor and the health of the adjacent estuarine system. That estuarine system includes the shallow and deep waters of Mississippi Sound and Bayou La Batre and forested, emergent, and submerged wetlands along and backlying the shoreline. The Service has three major areas of fish and wildlife concern at Bayou La Batre: (1) loss of wetlands due to residential/commercial development and dredged material disposal, (2) loss of wetlands due to shoreline erosion, and (3) degraded water quality due to inappropriate or inadequate treatment of local sewage and surface runoff.

The Corps of Engineers (Corps) proposes to deepen the Bayou La Batre channel to facilitate the establishment of additional types and sizes of seafood catching/hauling vessels. It is expected that new industry would be an economic boost to the Bayou La Batre area. Five channel depths, two channel alignments, and three general disposal options were studied. An 18-foot channel depth is the tentatively selected plan. The channel would follow its existing alignment south to the Gulf Intracoastal Waterway where the route would turn west and continue to the Pascagoula Harbor channel.

Three general disposal alternatives (upland, deep gulf, and openwater) have at least two resulting impacts in common: increased turbidity and induced development. The potential extent of either impact is not known; however, conducting dredging and disposal activities during late October to February would minimize turbidity impacts. Induced development could be controlled by local zoning, or by existing state and Federal permit programs.

Upland disposal of all dredged material is our preferred option; however, the Corps' tentatively selected plan involves upland disposal of Reach 1 material only. A less preferred alternative, deep gulf disposal of all dredged material was rejected due to operational and economic constraints. If open water disposal, particularly for Reach 2, is an absolute necessity, we believe Plan XII, which would place all the new work material along Isle aux Herbes, should be utilized. Plan XII, however, should be refined to eliminate potential impacts to existing marsh and to maximize the productivity of the resultant emergent bar and flats.

Presently, the Service supports the proposed project because environmentally acceptable disposal alternatives remain under consideration. However, if the tentatively selected plan becomes final, we recommend in addition to refinement of the Isle aux Herbes disposal, that a monitoring plan be designed and implemented to assess the environmental impacts of sidecasting new work material into Mississippi Sound.

Sincerely yours,

Larry E. Goldman

Larry E. Goldman
Field Supervisor

cc: EPA, Atlanta, GA
NMFS, Panama City, FL
ADCNR, Montgomery, AL
ADCNR, Spanish Fort, AL
ADCNR, Dauphin Island, AL
ADEM, Montgomery, AL
ADEM, Mobile, AL

FISH AND WILDLIFE COORDINATION ACT REPORT

on

BAYOU LA BATRE CHANNEL IMPROVEMENTS
BAYOU LA BATRE, ALABAMA

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Table of Contents

List of Tables

List of Figures

PURPOSE, SCOPE, AUTHORITY

The purpose of the study is to investigate the need for and viability of navigation improvements to the existing Federal channel at Bayou La Batre, Alabama. The proposed improvements would support increased or changing commercial vessel types (particularly shrimping vessels), offshore oil exploration service vessel activity, porting of small ships, and construction of vessels with a draft greater than 12 feet. The scope of the study involves improvements in navigational efficiency (e.g., increased depth, width, and/or length) that will accommodate new and larger vessels in the inner channel of Bayou La Batre and the outer channel in Mississippi Sound. The study also includes how such improvements interface with local developmental and environmental needs.

This study is being conducted based on a request from the City of Bayou La Batre to former U.S. Congressman Jack Edwards and under authority of a U.S. House of Representatives Public Works Committee resolution adopted October 10, 1974.

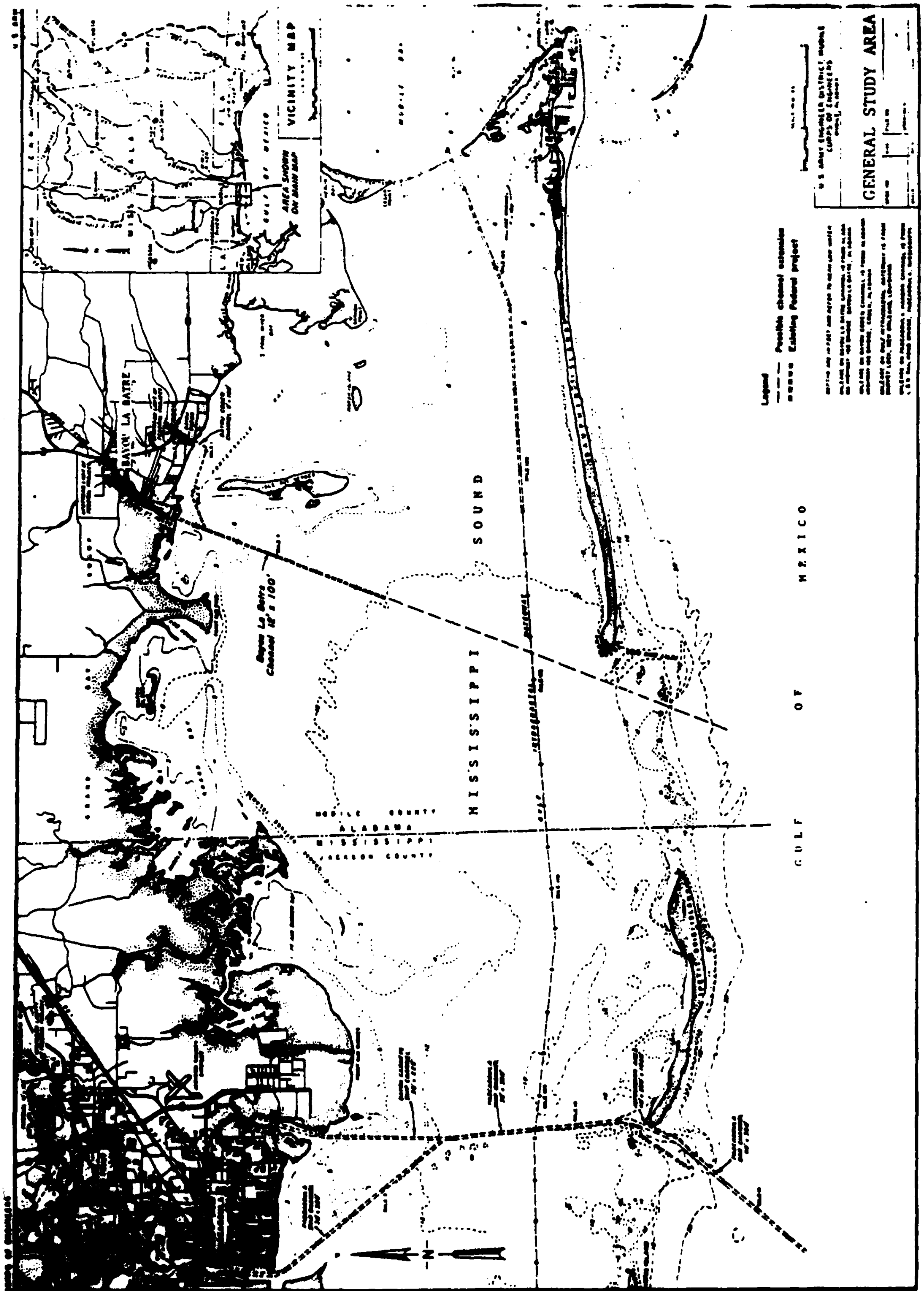
This final report is submitted for the purpose of providing U.S. Fish and Wildlife Service (Service) review and recommendations regarding the proposed navigation improvements and constitutes the report of the Secretary of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). This report evaluates each proposed depth and disposal alternative and provides a Service recommendation for the plan.

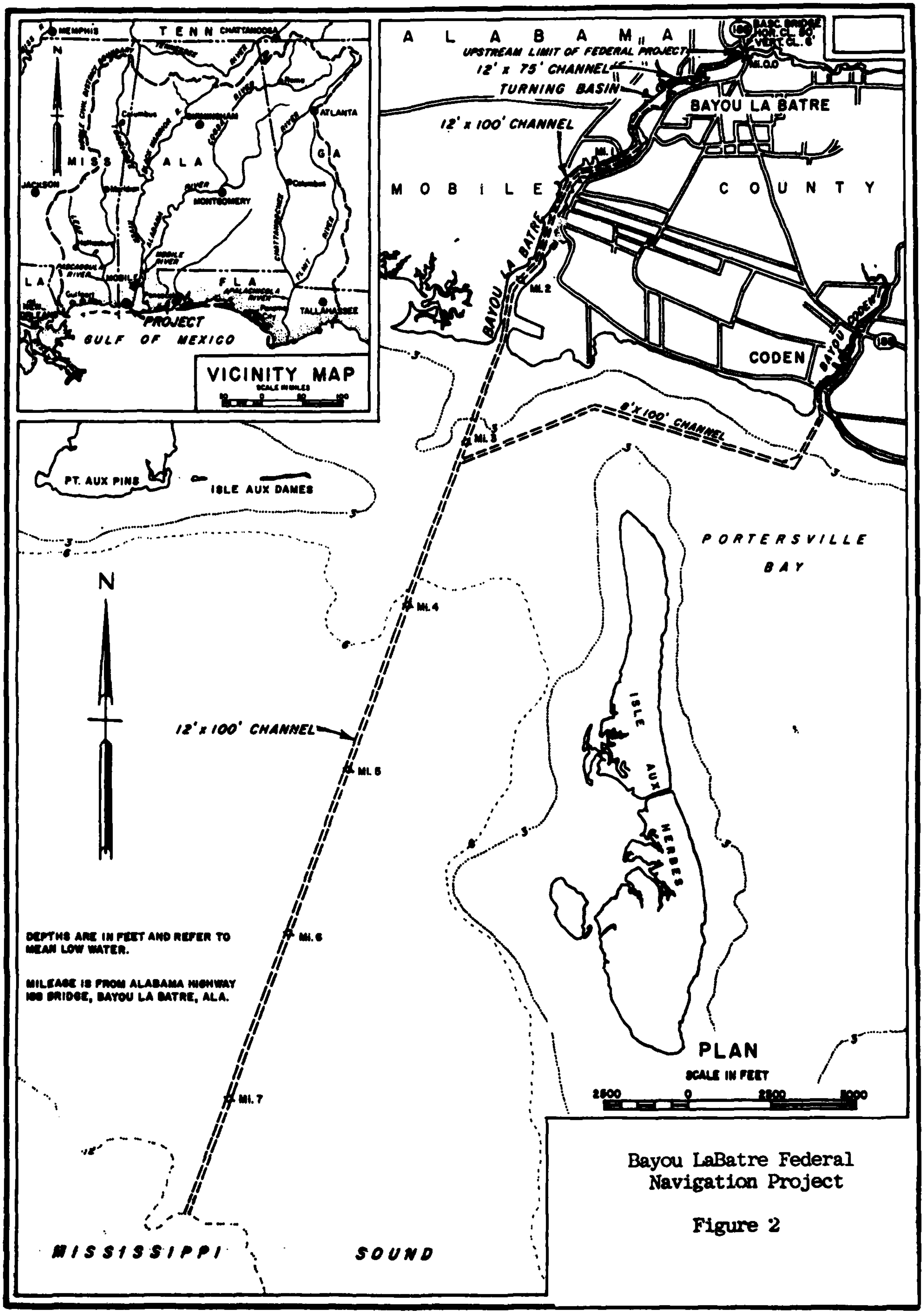
STUDY AREA DELINEATION

The Bayou La Batre study area consists primarily of the corporate limits of the town of Bayou La Batre; the inner channel extending from Mississippi Sound to the Alabama Highway 188 bridge; the outer channel through Mississippi Sound to the -24 foot depth contour in the Gulf of Mexico. The secondary areas of interest include the markets served by the commercial fishing industry; the area of biological impact in the Gulf of Mexico; and the area of Mississippi Sound which would be impacted by the relocation of dredged material, including Isle aux Herbes, Petit Bois Island, and Point aux Pins. The map on Figure 1 shows the general study area.

DESCRIPTION OF THE AREA

Bayou La Batre is a tidal stream about 10 miles long which empties into Mississippi Sound about 30 miles southwest of Mobile, Alabama. Practically all of the navigable lengths of the bayou and its tributaries are within the corporate limits of the town of Bayou La Batre. Additionally, the adjacent streambanks have been extensively developed to serve a large commercial fishing fleet and boat building and repair facilities. The existing Federal navigation project for Bayou La Batre (Figure 2) provides for a 12- by 100-foot channel from the 12-foot depth contour in Mississippi Sound to a point about 2,800 feet downstream of the Highway 188 bridge,


VICINITY MAP
AREA SHOWN ON MAIN MAP
GULF OF MEXICO
BAYOU LA BATRE
Bayou La Batre Channel 12' x 100'
MISSISSIPPI SOUND
MOBILE COUNTY
ALABAMA
MISSISSIPPI
JACKSON COUNTY
GULF OF MEXICO
Legend
Possible channel extension
Existing Federal project
GENERAL STUDY AREA
FIGURE 1



Bayou LaBatre Federal Navigation Project

Figure 2

thence a channel 12 by 75 feet upstream to the bridge, for a total channel length of about 6.3 miles. A turning basin is provided about 0.6 mile downstream from the bridge. Construction of these channel improvements was completed in March 1967.

FISH AND WILDLIFE RESOURCE CONCERNS AND PLANNING OBJECTIVES

The Bayou La Batre project presents environmental concerns typical of most Gulf of Mexico ports in that industrial/commercial development and maintenance/improvement of Federal navigation projects continue to encroach upon wetland and shallow bottom areas. Yet, the estuarine wetlands of the Bayou La Batre area are an important economic and ecological resource. Bayou La Batre is the leading fish landing port in Alabama (three-fourths of the state fish landings are at Bayou La Batre) and city residents rely on boat building and repair, fishing, and seafood processing for their livelihood. Also, according to the Service's National Wetland Inventory maps, the Bayou La Batre area had approximately 2,312 acres of brackish and saline marsh in 1955 but, by 1979, 1,925 acres remained (17% loss). Thirty percent of the wetland destruction was due to residential/commercial development or dredged material disposal. Considering the intensity of development along Bayou La Batre, the Service is concerned that the proposed harbor improvements would promote additional development into adjacent wetlands.

In addition to vegetated wetland losses, approximately 65 acres of shallow waterbottoms in Mississippi Sound have been converted to deep water as a result of channel construction. Another 450 acres of Mississippi Sound have been utilized for disposal of dredged material. Unfortunately, the full impact of past and proposed disposal activities on the physical, chemical, and biological conditions of Mississippi Sound are not known.

Natural shoreline erosion is another threat to wetlands in the Bayou La Batre area. National Wetland Inventory maps indicate 18 percent of the brackish and saline marsh loss between 1955 and 1979 was due to erosion. During the same time period, Isle aux Herbes (Coffee Island) just south of Bayou La Batre lost 87 acres (10 percent) of its marsh to erosion. According to a publication by the Alabama Department of Economic and Community Affairs (1984), Point aux Pins eroded approximately 6.0 feet per year between 1917 and 1958 while the eastern shore of Isle aux Herbes eroded about 7.0 feet per year during the same time period.

Water quality within Bayou La Batre imposes additional problems for fish and wildlife resources. The dead-end canal nature of the bayou tends to limit flushing and promote thermal stratification. Consequently, dissolved oxygen levels are naturally low at certain times of the year. For example, according to the Alabama Department of Environmental Management, in June and July of 1986 dissolved oxygen concentrations were 0.2 and 0.6 mg/l, respectively. The yearly average concentration was 4.0 mg/l. In July and August of 1987, dissolved oxygen concentrations were 0.0 mg/l. The yearly average concentration was 1.9 mg/l. This poor condition is accentuated by non-point source discharges of pollutants into the bayou due

to runoff from adjacent shipyards and spillage of oil and gas during routine boat servicing. The heavy metals and hydrocarbons settle into the bottom sediments where they impact bottom-dwelling organisms and are susceptible to resuspension into the water column in the event of major storm disturbances or dredging.

High fecal coliform levels have also been recorded in Bayou La Batre and Mississippi Sound. For example, the count was greater than 1200 colonies/ml in March 1986 and July 1987, and greater than 6000 colonies/ml in June 1986. Unauthorized discharge of waste waters from local seafood processors has contributed to the problem, as has the related requirement implemented to correct this situation whereby processors were required to divert waste waters into the local sewage treatment facility. As a result, when the seafood processors are operating, the municipal system is overloaded. The City of Bayou La Batre is in the process of upgrading its sewage treatment facility which should help to improve water quality within the bayou. However, other measures such as diverting storm drainage from the boatyard facilities away from the bayou, reverse berms to retain runoff at the waterfront, and conscientious control of fueling operations should give additional protection to water quality in the bayou. The water quality improvements would in turn enhance fishery habitat.

Based on our fish and wildlife resource concerns, our planning objectives involve coordinating with the Corps of Engineers and the other resource agencies to arrive at project alternatives that would: (1) provide for short- and long-term disposal needs, (2) minimize impacts to fish and wildlife resources, and (3) be consistent with Service recommendations for other coastal projects. In addition, it is our intent to, where possible, take advantage of opportunities to promote actions that would enhance local fish and wildlife resources. For example, the potential for utilizing a part of the new work dredged material to decrease erosion of vegetated wetlands along a portion of the coastline.

EVALUATION METHODS

Evaluation of this project's impacts on fish and wildlife resources in the project area are based on the best professional judgement of Service biologists. That judgement is based upon field inspections of the project area, review of pertinent literature, and professional experience. With respect to evaluation of mitigation needs, at this point mitigation has involved avoidance and minimization measures such that an estimation of compensation has not been necessary. If, however, the disposal alternative ultimately selected by the Corps involves destruction of significant fish and wildlife resources (e.g., utilization of estuarine marsh for dredged material disposal), the Service would likely recommend utilization of the Habitat Evaluation Procedures to assess compensation requirements.

FISH AND WILDLIFE RESOURCES

Endangered and Threatened Species

Forty one species of plants and 32 species of fish or wildlife are listed by the Service and state as being endangered, threatened, or of special concern and are known to occur in or visit the Bayou La Batre project area (Tables 1 and 2). Of particular interest are the many plant species unique to the pitcher plant bogs/pine savannahs that are common around Bayou La Batre and most of south Mobile County. Also, the Alabama shovelnose sturgeon (Scaphirhynchus sp.) spends time in the estuaries of Mississippi Sound and Mobile Bay and migrates up the Mobile Bay river system to spawn. Additionally, the range of the western population of the gopher tortoise (Gopherus polyhemus) includes the sandy ridge areas of the Bayou La Batre area. The piping plover (Charadrius melodus) prefers the open sandy beaches of Mobile County (particularly Little Dauphin Island) for its wintering grounds where it feeds extensively on marine invertebrates.

Several endangered sea turtles occur within the coastal waters of Alabama. The Atlantic ridley, Atlantic leatherback, and green sea turtle are infrequent visitors. However, the Atlantic loggerhead turtle is regularly found along the Alabama coast and habitually nests on the barrier islands, particularly Dauphin Island. Nesting occurs from May through August.

The Corps of Engineers has coordinated this project with the Service from an Endangered Species Act perspective (see letter in the Appendix). However, the gopher tortoise has since been included on the Federal list of threatened species. Even though no adverse effects on this species are currently expected, the tortoise and other species in Tables 1 and 2 should be given full consideration during final project planning and construction. For example, any new disposal areas should be located to avoid disturbance of the mentioned species of concern.

Fisheries Resources

Alabama's marine fisheries industry is one of the most important natural assets of the state and its success is directly related to the health of the estuarine system. Both the commercial and sport fishery significantly contribute to the economy of the Alabama coastal area.

The commercial marine fishery of Alabama is located in Mobile and Baldwin Counties with major landings at Bayou La Batre, Mobile, Coden, Gulf Shores, and Bon Secour. However, approximately 71 percent of Alabama's landings, comprising 30.4 million dollars in 1985 and 43.3 million dollars in 1986, make Bayou La Batre the seventh most productive marine fishery port in the United States. The major commercial fishery categories are shrimp, crab, oyster, and finfishes. Current landing data for these species reported from Bayou La Batre, Alabama, are shown in Table 3. Shrimping is economically the most important commercial fishery in Alabama and accounts for almost 91 percent of the retail value of all the commercial fishing in the State (Heath 1979).

Table 1. State Endangered and Threatened Plants of Mobile County
(E - Endangered, T - Threatened, SC - Special Concern) (Freeman et al. 1979)

Scientific Name	Common Name	State Status	Habitat Assoc.
Aquifoliaceae			
Ilex amelanchier		E	Swamp woodlands and acid areas
Aspidiaceae			
Thelypteris dentata	Fern	SC	Damp woods, shaded sinks, and disturbed ground
Thelypteris ovata	Fern	SC	Damp wooded ravines, ledges and bluffs
Thelypteris quadrangularis	Fern	SC	Swamp margins
Cannaceae			
Canna flaccida	Golden canna	T	Swamp near coast
Cupressaceae			
Chamaecyparis thyoides	Atlantic white cedar	SC	Acidic streambanks
Cyperaceae			
Rhynchospora crinipes	Beakrush	E	Savannah, flatwoods
Ericaceae			
Rhododendron austrinum		SC	Low, sandy woods
Eriocaulaceae			
Eriocaulon lineare	Pipewort	SC	Sandy, peaty edges of ponds
Eriocaulon texenes	Pipewort	SC	Pitcher plant bogs
Fabaceae			
Psoralea simplex		E	Wet pinelands
Fagaceae			
Quercus pumila	Running oak	SC	Low, sandy savannahs
Gentianaceae			
Eustoma exaltatum		SC	Edges of salt marsh, on sand
Gentiana villosa		E	Oak-pine-hickory woods
Sabatia foliosa		SC	Sandy, peaty low places
Hypericaceae			
Hypericum nitidum	St. Johns wort	T	Acid swales, bogs, acid pine savannah
Hypericum reductum	St. Johns wort	SC	Acid pine savannah

Table 1 (Cont'd). State Endangered and Threatened Plants of Mobile County
(E - Endangered, T - Threatened, SC - Special Concern) (Freeman et al. 1979)

Scientific Name	Common Name	State Status	Habitat Assoc.
Juncaceae			
Juncus gymnocarpus		T	Swamp woodlands
Lentibulariaceae			
Pinguicula planifolia	Butterwort	SC	Cypress domes and peat bogs
Utricularia floridana	Bladderwort	T	Low pH ponds
Utricularia inflata	Bladderwort	T	Lakes
Utricularia purpurea	Bladderwort	T	Low pH streams
Lycopodiaceae			
Lycopodium cernuum	Clubmoss	SC	Sphagnum seeps, moist slopes of ditches
Onagraceae			
Ludwigia arcuata		T	Pond banks, sandy peat
Ophioglossaceae			
Botrychium alabamense	Alabama grapefern	SC	Wooded slopes and old fields
Botrychium lunarioides	Winter grapefern	SC	Dry open woods and old fields
Ophioglossum crotalophoroides	Bulbous adders tongue	SC	Meadows
Ophioglossum nudicaule	Least adders tongue	SC	Pinelands
Orchidaeceae			
Cleistes divaricata	Spreading pogonia	T	Pineland bogs
Epidendrum conopseum	Green-fly orchid	E	Rich hammock woods and bottoms
Platanthera integra	Yellow fringeless orchid	SC	Swamp and pine barrens
Orobanchaceae			
Orobanche uniflora		SC	Alluvial woods
Poaceae			
Panicum nudicaule		T	Swampy, acidic creek bottoms
Rhamnaceae			
Segeretia minutiflora		T	Seastrand beaches
Sarraceniaceae			
Sarracenia psittacina	Pitcher-plant	T	Wet pine flatwoods
Selaginellaceae			
Selaginella ludoviciana	Spikemoss	SC	Moist pinelands and swamp margins

Table 1 (Cont'd). State Endangered and Threatened Plants of Mobile County (E - Endangered, T - Threatened, SC - Special Concern) (Freeman et al. 1979)

Scientific Name	Common Name	State Status	Habitat Assoc.
Theaceae			
Gordonia lasianthus	Loblolly bay	T	Pocosin borders
Stewartia malacodendron	Silky camellia	SC	No longer present
Ulmaceae			
Momisia iguanea		T	Beach strands
Xridaceae			
Xyris drummondii	Yellow-eyed grass	T	Acid sandy sites
Xyris scabrifolia	Yellow-eyed grass	T	Wet pinelands

Table 2. Endangered and Threatened Animals of Coastal Alabama
(E - Endangered, T - Threatened, SC - Special Concern, C - Candidate) (Mount 1986)

Scientific Name	Common Name	State Status	U.S. Status	Habitat Assoc.
Fishes				
Scaphirhynchus sp.	Alabama shovelnose sturgeon	E	C	Riverine
Amphibians				
Ambystoma cingulatum	Flatwoods salamander	E		Moist pine flatwoods
Rana areolata sevosa	Dusky gopher frog	T		Pine flatwoods
Reptiles				
Alligator mississippiensis	American alligator	T	T	River swamps
Caretta caretta caretta	Atlantic loggerhead turtle	E	T	Marine
Chelonia mydas	Green sea turtle	E	T	Marine
Crotalus adamanteus	Eastern diamondback rattlesnake	SC		Dry pine flatwoods
Dermochelys coriacea	Leatherback sea turtle	T	E	Marine
Drymarchon corais couperi	Eastern indigo snake	E	T	Pine-oaks
Eretmochelys imbricata imbricata	Atlantic hawksbill turtle	E	E	Marine
Gopherus polyphemus	Gopher tortoise	T	T	Pine-oaks
Heterodon simus	Southern hog-nose Snake	E		Open fields
Lepidochelys kempi	Atlantic ridley turtle	E	E	Marine
Malaclemys terrapin pileata	MS diamondback terrapin	SC		Saltmarsh
Masticophis flagellum flagellum	Eastern coachwhip	SC		Open pine flatwoods, sandhills
Nerodia fasciata clarki	Gulf saltmarsh snake	SC		Salt and brackish marsh
Pitophis melanoleucus lodingi	Black pine snake	E		Pine flatwoods
Birds				
Accipiter cooperii	Cooper's hawk	SC		Woodlands
Anas fulvigula	Mottled duck	T		Salt/brackish marsh
Charadrius melodus	Piping plover	SC	T	Sand beaches
Charadrius alexandrinus	Snowy plover	E		Outerbeaches
Egretta rufescens	Reddish egret	SC		Shallow water near saltmarsh, offshore islands
Falco columbarius	Merlin	SC		Open areas
Falco peregrinus	Peregrine falcon	E	E	Near water

Table 2 (Cont'd). Endangered and Threatened Animals of Coastal Alabama
(E - Endangered, T - Threatened, SC - Special Concern, C - Candidate) (Mount 1986)

Scientific Name	Common Name	AL Status	U.S. Status	Habitat Assoc.
Birds (Cont'd)				
Grus canadensis pulla	Ms sandhill crane	E	E	Moist pinelands
Haematopus palliatus	American oystercatcher	SC		Sandflats/beaches
Haliaeetus leucocephalus	Bald eagle	E	E	Near water
Mycteria americana	Wood stork	E		Freshwater
Pandion haliaetus	Osprey	E		Coastal woodland
Pelecanus erythrorhynchus	White pelican	SC		Shallow salt and fresh water
Pelecanus occidentalis	Brown pelican	E		Coastal
Picoides borealis	Red-cockaded woodpecker	E	E	Pinelands
Mammals				
Sciurus carolinensis fuliginosus	Bayou gray squirrel	SC		Riverine

Table 3. Pounds and value of commercial fish and shellfish landed at Bayou La Batre in 1987 (NMFS 1988)

Species	Pounds	Value[1]
Finfish	1,750,990	$1,100,461
Crabs	2,033,736	$ 830,228
Oysters[2]	79,476	$ 264,514

[1] Values are prices paid from the boat
[2] Oyster poundage is in terms of meat only

Public oyster reefs in Mobile Bay and Mississippi Sound cover over 3,000 acres. Most of these reefs are in the southern half of Mobile Bay. The major reefs include Klondike, Whitehouse, Bon Secour, and Cedar Point (Figure 3).

Many major marine fishes depend upon the estuarine waters of Mobile Bay and Mississippi Sound during some period of their life and are of commercial or recreational importance in Alabama including Atlantic croaker (Micropogonias undulatus), spotted seatrout (Cynoscion nebulosus), sand seatrout (Cynoscion arenarius), southern flounder (Paralichthys lethostigma), spot (Leiostomus xanthurus), gulf menhaden (Brevoortia patronus), and striped mullet (Mugil cephalus).

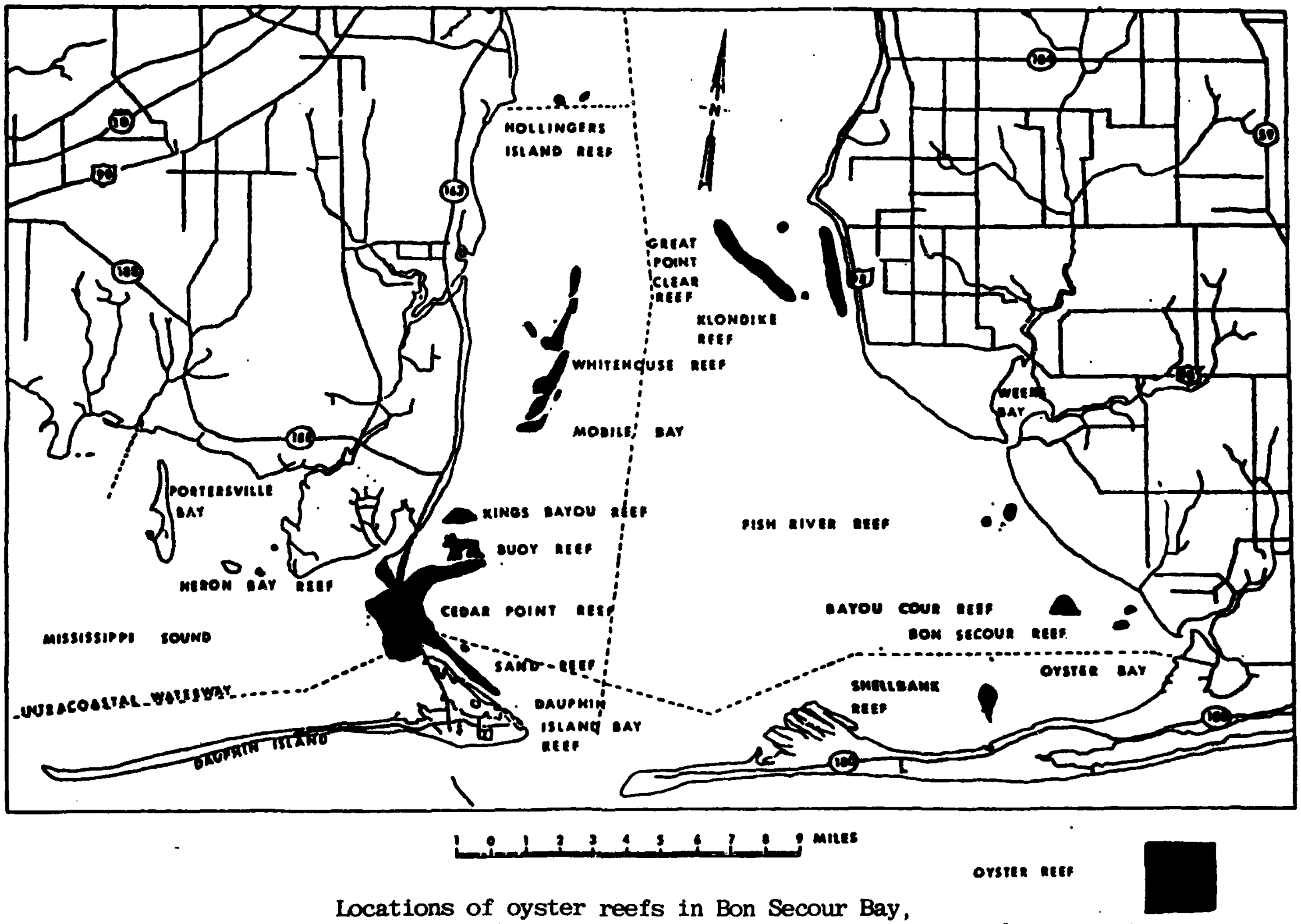
Recreational fishing in the coastal waters of Alabama also provides additional revenue to Mobile and Baldwin Counties. In 1986 an estimated 448,100 recreational saltwater fishing trips occurred in Alabama's coastal waters resulting in the expenditure of nearly $98,000,000 (Lazauski 1988). Approximately 92 percent of the trips occurred within the inshore waters of Mobile and Baldwin Counties. Major inshore sportfish species include spotted seatrout, sand seatrout, red drum, Atlantic croaker, and striped mullet.

Recreational shrimping is also popular among Mobile and Baldwin County residents. It was estimated that 4,961 recreational 16-foot trawls were used to harvest 277,051 lbs., 204,577 lbs., and 290,541 lbs. of shrimp in 1972, 1973, and 1974, respectively (Heath 1979). Although no statistics are available on recreational shrimping since 1974, it is suspected that harvest efforts have risen substantially.

The importance of palustrine and estuarine systems to the fishing industry and local economy is often not recognized. However, the critical association between fin and shellfishes and wetland habitats can be placed in perspective by examining the species' life cycles. A general description of several life cycles of important sport and commercial fin and shellfishes is provided.

The life stages of most estuarine dependent fishes are similar to the degree that they can be generally described. Basically adult fish spawn in the openwaters of the Gulf of Mexico. As the larval stages develop they are carried into the estuaries by currents through the various passes. As they reach the mouths of rivers and streams they are normally mature enough to swim into these systems that provide food and cover. Depending on the species, at maturity, adults may go to the gulf to spawn and then return to the estuary, remain in the gulf, or stay in the estuary.

The spotted seatrout is probably the most valued and sought after sport species along the Mississippi Sound. Its life history presents a typical marine-estuarine relationship. A recent study by the Alabama Marine Resources Division provided much information about the spotted seatrout in Alabama estuarine waters. The following discussion cites a summary of that information written by M. Van Hoose (1987). Spawning of the spotted seatrout in Alabama estuarine waters occurs over a 4-month period with two



Locations of oyster reefs in Bon Secour Bay, Mississippi Sound, and Mobile Bay, Alabama (Eckmayer 1979)

Figure 3

postlarval peaks, one in mid-June to early July and the larger in early September. It is unknown whether spawning occurs in the estuary or the gulf; however, postlarval and early juvenile stages are rarely found during gulf sampling. Postlarval stages of the spotted seatrout are habitat specific to the grass flats at Coden while early juvenile stages prefer tidal river mouths and channels. Adults often concentrate in deep water and are known to prefer tidal rivers (particularly Fowl River and Bayou La Batre) during winter.

Like most marine finfishes, the life cycles of the brown and white shrimp are greatly dependent upon the estuaries. Shrimp constitutes the most important commercial shellfish species within Mississippi Sound and the project area. In 1986 about 10 million lbs. valued at nearly 37.5 million dollars were landed at Bayou La Batre (NMFS, 1988). Brown shrimp are harvested from May to August and represent a relationship to the estuary that is typical for shrimp in the northern gulf. Peak spawning in offshore waters occurs from around November to April. After fertilization, the demersal eggs of both brown and white shrimp become planktonic larvae and go through numerous development stages. Recruitment of the postlarval brown shrimp into the estuary mainly occurs from February through April (Baxter and Renfro 1967); Gaidry and White 1973; White and Boudreaux 1977). Transformation into the juvenile stage occurs in about 4 to 6 weeks after entering the estuary (Perez-Farfante 1969). Peak emigration periods are found from May through August. After leaving the estuaries the brown shrimp make their way toward the deeper spawning grounds. All feeding stages of brown shrimp are omnivorous. The larvae feed mainly on algae and zooplankton. Postlarvae feed on detritus, algae and microorganisms, and adults feed on detritus and benthic organisms.

While shrimp provide an excellent food item for human consumption and contribute significantly to the economy of the region, another important if not the most important function is that they are a major component in the food web that sustains many commercially important species.

Another important commercial and recreational shellfish that is dependent upon the estuary is the blue crab (Callinectes sapidus). Mating generally occurs in the relatively low salinity waters in the upper areas of the estuaries. Females usually move to higher salinity waters to spawn (Tatum 1979). The growth and development of the blue crab consists of a series of larval, juvenile, and adult stages. The rate of development depends on temperature and salinity.

The developing larvae swim freely but mostly in high salinity estuarine areas (Tagatz 1968). As they molt to the juvenile stage, the juveniles migrate into the lower salinity waters of the upper estuaries where they grow and mature (Fischler and Walbury 1962). At this point, the young crabs constitute a prime food source for predatory fish like the red drum.

Wildlife Resources

The palustrine and estuarine wetlands of the Bayou La Batre area provide a rich diversity of wildlife habitat. The following discussion describes this habitat and its value.

Forested wetlands within the project area are basically two types: pitcher plant bogs/pine savannahs which form a strip between floodplain swamp and upland pine-oak forests, and floodplain swamps. The pitcher plant bogs are freshwater wetlands with an open pine overstory (generally slash pine (Pinus elliottii). Moisture is usually maintained due to an underlying layer of clay that holds water near the ground surface. The typical understory includes pitcher plants (Sarracenia spp.), clubmoss (Lycopodium spp.), and sundews (Drosera spp.) with a diverse association of water-tolerant sedges and grasses. Pitcher plant bogs contain a large number of plant species that are unique to bogs and, consequently, are relatively rare. The wettest portions of the bogs include baldcypress (Taxodium distichum) while the drier areas, or areas that have had minimal burning, develop a shrubby understory of gallberry (Ilex spp.) and wax myrtle (Myrica cerifera).

The second forested wetland type is the floodplain swamp. These forests are characterized by species such as sweetbay (Magnolia virginiana), swamp tupelo (Nyssa sylvatica var. biflora), and water oak (Quercus nigra). Under the shade of this bay forest grow small trees such as Virginia willow (Itea virginica), and fetterbush (Lyonia lucida), while open areas develop thickets of titi (Cyrilla racemiflora), and buckwheat tree (Cliftonia monophylla).

The vegetative diversity of the forested wetlands provide habitat for a diversity of wildlife species. For example, white-tailed deer utilize the thickets for cover and the open herbaceous areas for feeding. Wood duck, raccoon, and songbirds take advantage of the cavities for nesting and feed heavily on the berries within the thickets. Other wildlife species that occur in forested wetlands include beaver, swamp rabbit, gray squirrel, gray fox, and yellow-crowned night heron.

In addition to their value as terrestrial wildlife habitat, forested wetlands buffer backlying uplands from storms and filter upland runoff before it enters adjacent streams or estuarine marsh. Furthermore, forested wetlands (particularly floodplain swamps) export organic material to the aquatic system where it forms the base of the food chain.

In general, the estuarine system includes tidal habitats that have access to the open ocean and are at least occasionally diluted by freshwater runoff from land. The estuarine marshes within the Bayou La Batre project area are characterized by black needlerush (Juncus roemerianus) with some big cordgrass (Spartina cynosuroides) and saltmeadow cordgrass (S. patens). Smooth cordgrass (S. alterniflora) generally occurs as a fringe along the openwater marsh edges. The submerged grassbeds within the project area occur in shallow water areas of 6 feet or less depth. Typically, the grassbeds are vegetated by widgeon grass (Ruppia maritima); however, in

some arear of Mississippi Sound, shoaling has favored the establishment of the more salt-tolerant shoalgrass (Halodule wrightii).

The waterbottoms, grassbeds, and tidal marshes within the estuarine system provide vital spawning, nursery, and feeding habitat for a major portion of the marine and freshwater finfishes and shellfishes that inhabit the Alabama coastal zone. The detrital material produced in the estuary is a major food item of many marine fishes and lower food chain organisms.

The intertidal marshes within the project area support diverse wildlife populations. Many species of mammals, birds, reptiles, and amphibians are associated with these estuarine habitats including marsh rabbit swamp rabbit, nutria, mink, and raccoon. Tidal marshes also provide important feeding and cover habitat for many species of ducks including mallard, gadwall, American wigeon, lesser scaup, and mottled duck. Rails, gallinule, and snipe also inhabit the tidal marshes. King rail and clapper rail both nest and winter in the marsh but the Virginia rail and sora are considered winter residents. The common snipe winters in the fresh to brackish marshes as well as other wet areas (e.g., pine savannah).

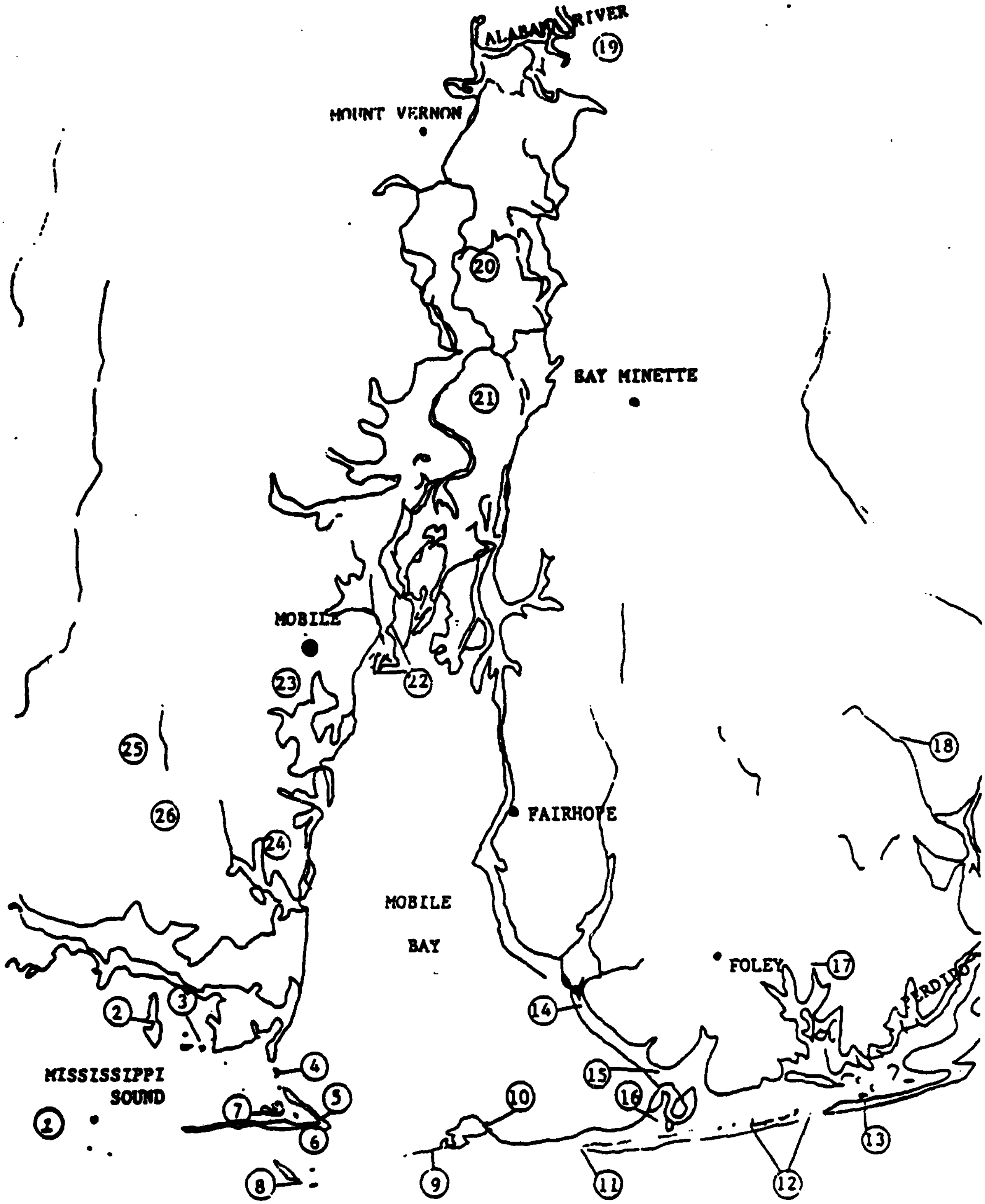
Wading birds utilize the tidal marshes for feeding and nesting purposes. Twelve species of wading birds are reported to nest in eight colonial nesting sites along the Mobile County coastline (Johnson 1979). These colonies are identified in Figure 4 and Table 4 (colonies 1-8).

Shorebirds are common inhabitants of the marsh habitat and intertidal shorelines and include black-necked stilt, killdeer, American oystercatcher, black-bellied plover, greater yellowlegs, lesser yellowlegs, sanderlings, and sandpipers. Other birds which occur in the estuarine marshes include the northern harrier and red-winged blackbird.

Seabirds are usually more common over the open waters of the area; however, they feed on small fishes which are dependent on marshes for food and cover. Those present include brown pelican, white pelican, ring-billed gull, herring bull, laughing gull, Forster's tern, common tern, sooty tern, least tern, royal tern, and black skimmer.

Amphibians and reptiles are generally restricted to the fresh marshes, open ponds, and lakes within the intertidal zones. Major amphibians within the Bayou La Batre area include the bull frog, pig frog, and southern cricket frog. Reptiles which inhabit the various intertidal marshes include the American alligator, western cottonmouth, red-eared turtle, diamondback terrapin, and gulf salt marsh snake. Of these, only the gulf salt marsh snake and diamondback terrapin are common in the brackish to saline marshes.

Tidal marsh and seagrass beds are, as with forested wetlands, also valuable because of their ability to buffer storm surges and filter overland runoff. Additionally, these tidal habitats are vital for impeding shoreline erosion.



Map indicating the location of wading birds nesting colonies identified for coastal Alabama (see Table 4 for location identification for coastal Mobile County sites) (Johnson 1979)

Figure 4

Table 4. Location of wading bird nesting colonies along coastal Mobile County (Johnson 1979)

Colony Number	Location of Colony	Species Present
1	Petit Bois Island	Cattle Egret Great Egret Louisiana Heron
2	Isle Aux Herbes	Louisiana Heron
3	Cat Island	Great Egret Snowy Egret Cattle Egret Louisiana Heron Little Blue Heron Reddish Egret Green Heron Glossy Ibis White-faced Ibis White Ibis
4	Grants Isle	Louisiana Heron Snowy Egret
5	Pass Drury, Dauphin Island	Little Blue Heron
6	Audubon sanctuary, Dauphin Island	Great Blue Heron
7	Salt Creek, Dauphin Island	Green Heron Black-crown Night Heron
8	Sand Island	Reddish Egret

PROJECT ALTERNATIVES AND DISPOSAL OPTIONS

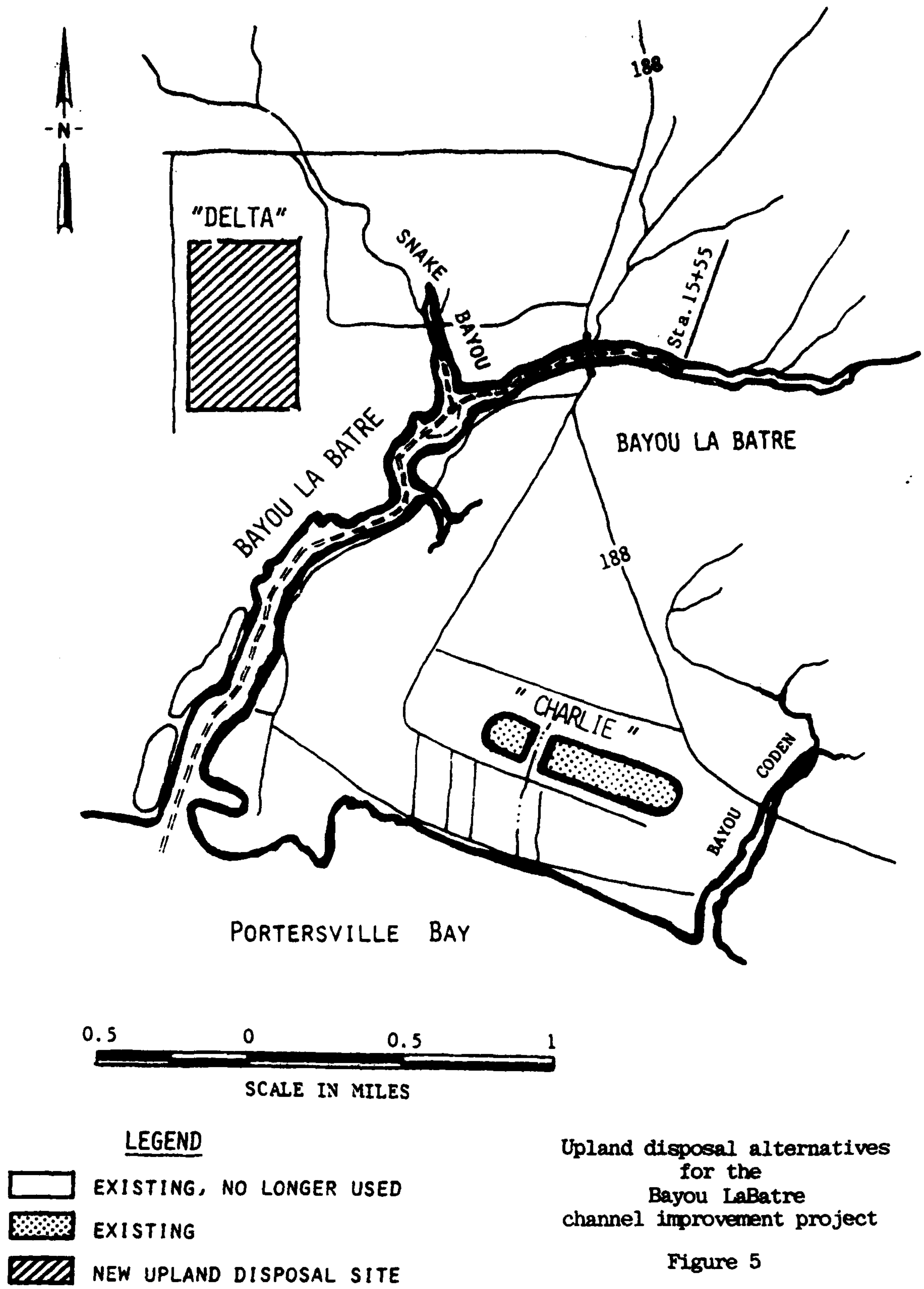
Five channel depths (14, 16, 18, 20, and 22 feet) and two channel routes (Gulf Intracoastal Waterway (GIWW) and Petit Bois Pass) were studied by the Corps. Economic analysis indicates the best option would be an 18-foot deep channel from Bayou La Batre that would meet the GIWW and run west to the Pascagoula Channel in Mississippi. The channel within the bayou would be 18 feet deep up to the turning basin but 14 feet deep north of the basin and into Snake Bayou. Mississippi Sound and GIWW portions of the channel would be widened to 120 feet, but due to adjacent development the channel within the bayou would remain 100 feet wide up to the turning basin and 75 feet wide north to the project end. An alternative 150-foot-wide channel through Petit Bois Pass was considered but discarded due to economic constraints.

The disposal options are segregated on the basis of where the material would be dredged; i.e., within the bayou (Reach 1), from the bayou mouth south to the GIWW (Reach 2), and from Mississippi Sound channel through the GIWW west to the Pascagoula channel (Reach 3). Three general disposal options are being analyzed: upland disposal, deep gulf disposal, and openwater disposal.

Several upland disposal sites were analyzed during plan formulation. Under their preferred plan, the Corps intends to place all material dredged (new work and maintenance material) from Reach 1 into two upland disposal sites adjacent to Bayou La Batre (Figure 5). "Charlie" is approximately 70 acres in size and was utilized as a disposal area in 1983. A new site, "Delta", is approximately 107 acres of pine forest that would be diked and managed as a second long-term dredged material disposal site.

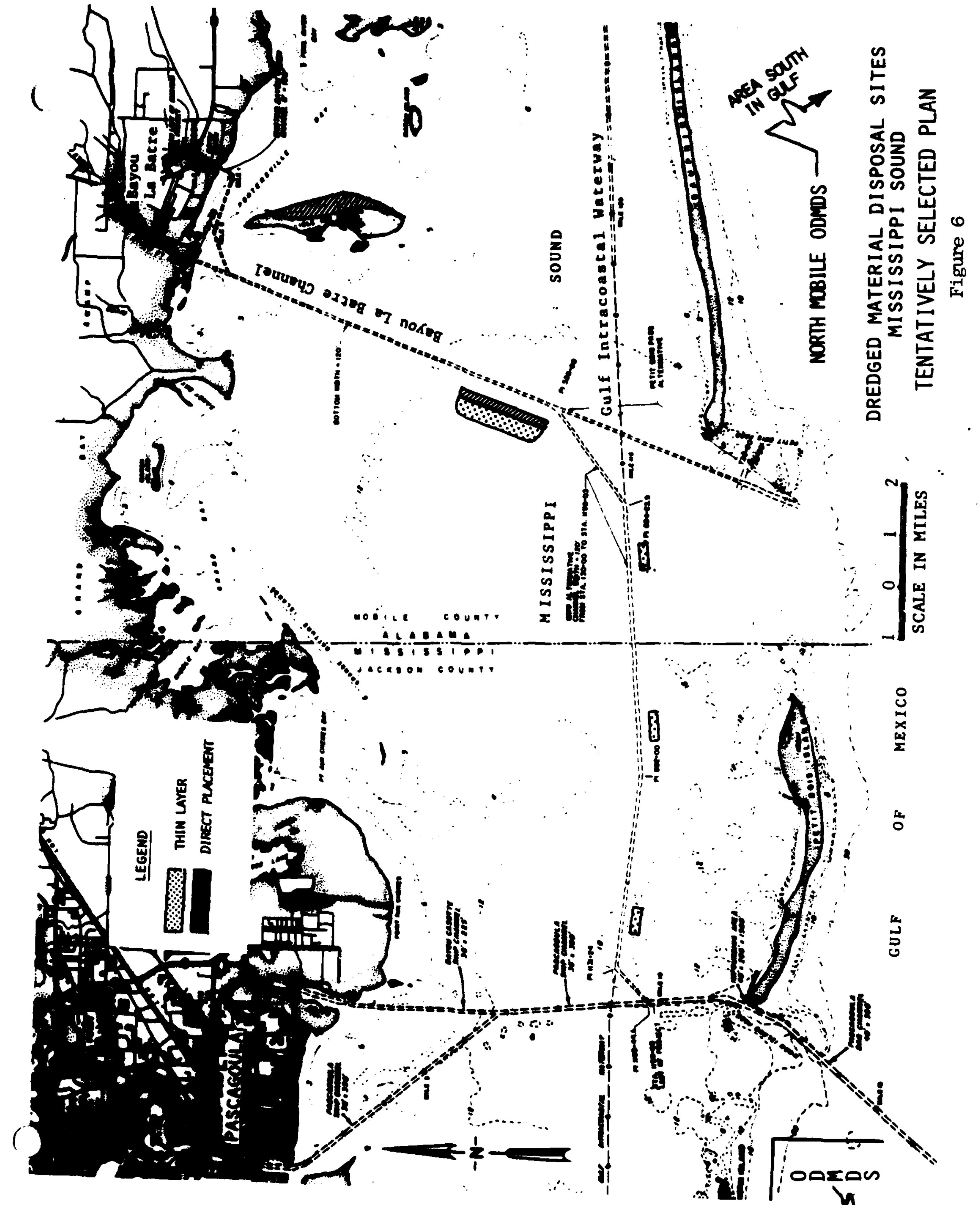
Deep gulf disposal would involve placement of dredged material into select gulf sites. Two sites were identified for such disposal purposes (Figure 6). The Mobile/north site is located between 2 and 6 miles due south of Dauphin Island, Alabama. It ranges in depth from 20 to 58 feet. The Pascagoula site is not yet formally designated but the interim site is approximately two nautical miles southeast of the eastern end of Horn Island, Mississippi. This site has water 36 feet deep and encompasses about 1,000 acres. Both gulf disposal sites have sand bottoms; however, ongoing substrate studies by the Dauphin Island Sea Laboratory indicate that low-relief hard bottom environments suitable for reef-building organisms occur south and east of the Mobile/north site and may also occur within that site. The Corps considered placement of new work and maintenance material from Reaches 2 and 3 in the deep gulf disposal areas; however, these alternatives were eliminated due to operational constraints.

The third general disposal option, openwater, included consideration of four alternative configurations for dredged material disposal on Mississippi Sound waterbottoms: (1) sidecasting the dredged material along the channel cut, (2) shallow water disposal to nourish/protect shorelines, (3) thin-layer disposal of dredged material, and (4) creation of an underwater berm of dredged material (see Figure 6). Except for the shallow water alternatives, the openwater disposal options would be in water 12



Upland disposal alternatives
for the
Bayou LaBatre
channel improvement project

Figure 5



DREDGED MATERIAL DISPOSAL SITES
MISSISSIPPI SOUND
TENTATIVELY SELECTED PLAN
Figure 6

feet or greater in depth. The underwater berm has been dropped from consideration due to economic constraints; however, the Corps' preferred disposal plan includes the other three configurations.

Approximately 1.3 million cubic yards of new work material from Reach 2 would be placed along the northeast shoreline of Isle aux Herbes such that 160 acres of shallow waterbottom would be affected. Of the 160 acres, approximately 60 acres would be converted to emergent bar while the remaining area would be an intertidal or submerged flat. The other 0.7 million cubic yards of new work material would be sidecast west of the Reach 2 channel such that 600 acres of waterbottom would be covered with a layer of dredged material 2 feet or less thick (see Figure 6). The maintenance of Reach 2 would involve thin-layer disposal of 430,000 cubic yards of material on a 3-year cycle. The thin-layer disposal action would cover about 415 acres of waterbottom with a 1-foot or less thick later of sediment and would be west of the channel.

For Reach 3, approximately 485,500 cubic yards of new work material would be sidecast south of the channel to cover about 300 acres of waterbottom (see Figure 6). Maintenance material would be dredged on a 3-year cycle and thin-layered onto 90 acres of waterbottom.

Other disposal alternatives were studied but were dropped from consideration due to economic, operational, or environmental constraints. Of particular interest to the Service is the plan that would utilize the entire 2.0 million cubic yards of dredged material from Reach 2 for construction of a berm along virtually the full length of Isle aux Herbes' eastern shoreline. This alternative would otherwise involve the same area of waterbottom as the Corps' preferred plan except that 240 acres rather than 160 acres of shallow waterbottom would be covered by new work material.

PROJECT IMPACTS

General

The Bayou La Batre Channel Improvement Project would involve impacts to fish and wildlife resources in the area. Since no quantitative habitat assessments have been conducted for the impact areas, the discussion of expected impacts herein will be primarily in qualitative terms. For example, it is expected that the improved channel would boost the local seafood industry by allowing larger boats serving different markets to enter the port (e.g., butterfish and surimi). Additionally, the shrimp harvest is expected to increase by 2 percent each year up to the maximum harvestable catch. The Corps has speculated, and we agree, that the projected economic boosts would have an impact on the land use at Bayou La Batre. It is likely that wetlands existing adjacent to the bayou (approximately 80 acres) would be threatened by pressure to provide more docking and offloading space along the waterfront. Destruction of tidal marsh or backlying forested wetlands would remove those areas from use by

fish and wildlife, and negate their functional values (e.g., filtration, stabilization, etc.) as well.

A second impact that is ubiquitous for this type of project is increased turbidity due to dredging and dredge material disposal. Unusually high turbidity levels can clog fish respiratory systems; however, a major impact of high turbidity is decreased productivity or fatalities to planktonic forms. High turbidity levels also translate into a sediment deposition that covers and may kill benthic organisms. Additionally, the suspended sediments may cause additional problems by reintroducing contaminants into the water column.

Specific Disposal Options

Upland

Upland disposal of dredged material would involve no significant impacts to fish and wildlife if Disposal Area "Charlie" is utilized as it currently exists. Also, based on our 1988 field inspection of Disposal Area "Delta", we do not expect its use to involve significant impacts to fish and wildlife resources.

Deep Gulf Disposal

The deep gulf disposal options are no longer being considered; however, if these areas were utilized, we would not expect this disposal option to result in significant impacts to fishery resources. While the two deep water sites provide fish and shellfish spawning habitat, we do not have sufficient information to indicate that these specific areas are a critical spawning habitat (Harmon Engineering & Testing, 1983). Though there are obviously impacts from increased turbidity levels and smothering benthic organisms, we believe the impacts would generally be less severe than disposal in shallow estuarine waters. The above notwithstanding, because the Dauphin Island Sea Laboratory has determined that hard bottom exists in adjacent areas, if disposal were seriously considered in these areas, it might be necessary to avoid portions of the designated Mobile north disposal site in order to avoid adversely affecting that resource. The Corps would have to determine if these resources are present and, if so, take appropriate steps to avoid impacts in final project plans.

Sidecasting Along the Channel

There is little information available to quantify the impacts on aquatic resources of sidecasting dredged material along the channel. However, the results of the Environmental Protection Agency's bioassays indicate that the acute toxicity of the channel sediments is minimal. Additionally, the proposed alternative involves sidecasting in water 12 feet or deeper such that impacts to circulation and navigation should also be minimal. Nevertheless, there would be significant impacts to the benthic population due to physical covering of their habitat. Recolonization could only occur in areas not subject to disposal of maintenance material. The rate of that

recolonization is not known but would likely be different than for maintenance material (12 to 18 months).

Shallow Water Disposal to Nourish Shorelines

Shallow water disposal options at Point aux Pins and Petit Bois Island were considered but rejected due to possible adverse impacts on submerged grassbeds. The alternative to place the new work material in Petit Bois Pass was rejected because economics support a GIWW channel outlet rather than a Petit Bois Pass outlet to the Gulf of Mexico.

Shallow water disposal along the eastern shore of Isle aux Herbes would have positive impacts on the existing tidal marsh by, at least temporarily, reducing erosion in that area. Adverse impacts to the same marsh may occur, however, if the action is not designed and implemented to avoid direct or indirect filling of marsh during disposal. Additionally, existing inlets along the island's eastern shore would be cut off from tidal exchange unless the created berm is open to allow unimpeded water flow. Portions of the slackwater area created between the island and berm might become colonized by adjacent vegetation, thus, establishing marsh where it existed prior to erosion.

Thin-Layer Disposal

Thin-layer disposal of dredged material is a relatively new method that has been promoted by the Corps as an easy solution to dredge material disposal needs. Though we have significant reservations regarding thin-layer disposal of new work material, we are not particularly concerned about the Corps' plan to thin-layer maintenance material west of the navigation channel. The material would be placed in 12 feet or deeper water and would involve a somewhat smaller quantity of maintenance material than is currently being deposited along the channel. There would, however, be long-term impacts to benthic invertebrates in the area. Though the disposal area would recolonize to a certain extent within 18 months, periodic maintenance dredging (every 3 years) would redisturb 500 acres of the 600 acres of waterbottom that would be covered initially. In other words, for only 18 months of every 3 years would the benthic population be stable. Consequently, it would be at least 50 years before the benthic population would be able to return to preproject conditions.

Coastal Barriers Resources Act

The Coastal Barriers Resources Act (...) (PL97-348), enacted on October 18, 1982, is broad legislation resulting from Congressional concern over burgeoning Federal expenditures in coastal areas. Most concern was voiced over expenditures in coastal barrier areas which are subject to frequent drastic change from natural forces. The purpose of the Act is to minimize the loss of human life, wasteful expenditures of Federal revenues, and damage to fish, wildlife, and other natural resources associated with coastal barriers. CBRA establishes the Coastal Barrier Resources System (CBRS) consisting of a series of units along the Atlantic and Gulf Coasts.

Under CBRA, no new expenditures or new financial assistance may be made available under authority of any Federal law for any purpose within the CBRS, except as provided in Section 6 of the Act. Expenditures or financial assistance made available under authority of any Federal law shall be new if:

"(1) in any case with respect to which specific appropriations are required, no money for construction or purchase purposes was appropriated before the date of the enactment of this Act; or

(2) no legally binding commitment for the expenditure or financial assistance was made before such date of enactment."

Under Section 6, the appropriate Federal officer, after consultation with Department of the Interior, may make Federal expenditures or financial assistance available within units of the CBRS if the proposed action falls within the following exceptions:

(1) facilities necessary for energy exploration and development
(2) ship channel maintenance and dredge disposal
(3) maintenance of highways
(4) military activities essential to national defense
(5) Coast Guard facilities
(6) Activities permitted, if compatible with the purposes of the CBRA, including:

  (a) management of fish, wildlife, and their habitat
  (b) establishment of air and water navigation devices
  (c) projects under the Land and Water Conservation Act and Coastal Zone Management Act
  (d) scientific research
  (e) emergency actions related to disaster relief
  (f) maintenance of roads not a part of an essential system
  (g) non-structural projects for shoreline stabilization.

The activities can only be conducted after consultation with the Secretary of the Interior. This responsibility has been delegated to the Regional Director, Fish and Wildlife Service.

As tentatively planned, the Bayou La Batre project would not involve any units within the CBRA.

Endangered Species

A listing of fish and wildlife species that presently require consideration under the Endangered Species Act and are associated with the project area has been provided in Tables 1 and 2. We recommend the Corps take every precaution in fulfilling its obligation to ensure that those species listed

or being reviewed for possible listing receive adequate consideration during the planning process. Presently, the project is not expected to have significant impact on endangered species. It is the responsibility of the Corps to determine the actual presence of listed species and anticipated impact of the project on those species. Should the Corps anticipate an impact on listed species, you are required to initiate consultation with the Service to determine if the expected impact will jeopardize the continued existence of that species.

SUMMARY AND RECOMMENDATIONS

The economic health of the Bayou La Batre area is dependent on both the continued utility of the harbor and the health of the adjacent estuarine system. Consequently, the selected project depth and disposal options should not compromise either asset. The Service has coordinated with the Corps throughout the planning process. Potential project impacts have been significantly reduced through coordination and the resultant consideration of fish and wildlife resources. There are, however, additional measures that should be incorporated into project plans to further reduce impacts to those resources.

In general, we recommend that dredging and disposal activities be conducted during late October to February in order to minimize impacts to spawning fish and shellfish. Short of local zoning, induced development will have to be controlled via the existing permit programs administered by the Corps and the Alabama Department of Environmental Management. The Service would oppose proposals for non-water dependent development in wetlands and would likely recommend mitigation for water dependent proposals that would involve significant impacts to fish and wildlife resources.

We commend the Corps on their success in confining Reach 1 material to upland disposal areas that involve no wetland destruction. We would prefer that all dredged material, including that from Reaches 2 and 3, be placed in contained upland sites (assuming use of the disposal sites would not involve significant fish and wildlife losses). However, based on Corps study, such an alternative has proven to be impractical due to economic and engineering limitations. In lieu of upland disposal, we would prefer that all dredged material be placed in the designated gulf disposal areas. The Corps rejected this alternative for new work material based on economics. However, we note that the benefit to cost ratio for this alternative is positive, 1.95, and annual project costs exceed those of the Corps preferred plan by only 12.5 percent ($273,700). Gulf disposal of maintenance material was rejected due to operational and economic constraints.

In our draft report we stated our preference for placement of all new work material from Reaches 2 and 3 into Petit Bois Pass where it could best be utilized to reduce wave energy, and, therefore, erosion within Mississippi Sound. Such an alternative was not considered by the Corps, presumably because of similar operational and economic constraints as described for the deep gulf disposal alternative.

Based on the Corps' tentatively selected plan, some form of open water disposal may inevitably be utilized for Reach 2 and 3 dredged material. The project alternative offering the most promise is Plan XII, which involves placement of the entire 2 million cubic yards of new work material along the east side of Isle aux Herbes. Our position, as set forth below, is based on information that indicates the marshes of Isle aux Herbes have been and are continuing to erode at a significant rate, and that the new work material would be suitable for constructing a protective berm. Additionally, we do not expect that the opportunity to use such quality material will be available in the future. Our support of Plan XII over Plan XI (the Corps' selected plan) is also based on our concern regarding the unknown impacts of sidecasting new work material into Mississippi Sound. Plan XII, however, needs substantially more definition and refinement. We are concerned that no fill occur in the tidal inlets or the marsh of Isle aux Herbes. Also, the proposed dike should not meet the island on its south end so that the disposal area would be intertidal. The intertidal nature of the disposal area should be maintained; i.e., Corps plans should provide for periodic maintenance of the dike opening. Project details should also include provisions for establishment of an interagency review team to track the fate of the disposed sediment and the slackwater area to its interior. The team would decide when and if maintenance measures are needed. Additionally, the potential conflict between disposal of dredged material from maintenance of the Bayou Coden channel and dredged material from the Bayou La Batre channel improvements should be resolved. The final project documents should include specific details so that the purpose, objectives, and expectations of the disposal plan can be easily discerned by the reader.

Presently, the Service supports the proposed project because environmentally acceptable disposal alternatives remain under consideration. However, if the Corps' tentatively selected plan is the alternative funded by Congress, we believe refinement of the Isle aux Herbes disposal action is necessary before the plan is implemented (see above discussion). Additionally, we recommend a monitoring plan be designed and implemented to assess the environmental impacts associated with the sidecasting of new work material in Mississippi Sound. A scope of work at least as detailed as that used for monitoring the open-water thin-layer disposal at Fowl River, Alabama, would be acceptable provided measures were taken to schedule the study outside of the peak shrimping seasons (May to June for brown shrimp and September to October for white shrimp). Also, the study area should be managed such that shrimp trawling activities or other perturbances do not occur within its boundaries during the monitoring period.

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APPENDIX A

United States Department of the Interior
FISH AND WILDLIFE SERVICE
JACKSON MALL OFFICE CENTER
300 WOODROW WILSON AVENUE, SUITE 316
JACKSON, MISSISSIPPI 39213

April 20, 1987

IN REPLY REFER TO:
Log No. 4-3-87-230

All

Mr. N. D. McClure
Chief, Environment & Resources Branch
U.S. Army Corps of Engineers
Post Office Box 2288
Mobile, AL 36628-0001

Dear Mr. McClure:

This responds to your letter of April 8, 1987, requesting endangered species information for the vicinity of Bayou La Batre, Alabama.

The Fish and Wildlife Service (FWS) has proposed to list the western population of the gopher tortoise (Gopherus polyphemus) as a threatened species. This population occurs from the Tombigbee and Mobile Rivers in Alabama to southeastern Louisiana. Habitat for the gopher tortoise is well-drained sandy soils in transitional (forest and grassy) areas. It is commonly associated with a pine overstory and an open understory with a grass and forb groundcover and sunny areas for nesting. If this type habitat exists within your project area, care should be taken to avoid adverse impacts to the gopher tortoise. If the involved Federal agency determines that this or other projects of Federal involvement are likely to jeopardize the continued existence of the gopher tortoise, then a conference, as defined in the Endangered Species Act, with the FWS is required. If the above situation does not exist, then no further consultation is necessary.

If the subject proposal becomes final and the gopher tortoise is determined to be a federally listed species, then formal consultation should be initiated if through a review of this or other actions of Federal involvement it is determined that such action "may affect" this or other listed species.

The Vertebrate Animals of Alabama in Need of Special Attention mentions two sightings of jaguarundi near Bayou La Batre; however, the presence of this endangered mammal has not been substantiated.

For further endangered species coordination on this project, please contact Mike Dawson of our staff, telephone 601/965-4900, FTS 490-4900.

We appreciate your participation in the effort to protect endangered species.

Sincerely yours,

James H. Stewart

James H. Stewart
Acting Field Supervisor
Endangered Species Field Office

cc:
Division of Game and Fish, Montgomery, AL
Field Station, FWS, Daphne, AL

SECTION D-7

ENDANGERED SPECIES LETTERS

April 8, 1987

Coastal Environment Section

Mr. Dennis B. Jordan
U. S. Fish and Wildlife Service
Endangered Species Field Office
300 Woodrow Wilson Avenue
Suite 3185
Jackson, Mississippi 29213

Dear Mr. Jordan:

The U. S. Army Corps of Engineers, Mobile District, is preparing a Draft Environmental Impact Statement for channel improvements at Bayou La Batre, Alabama. A map of the project area is enclosed.

As required by Section 7 of the Endangered Species Act, we are requesting a list of endangered and threatened species that may occur in this area.

In order to meet our study schedule, a reply to the above request by May 8, 1987, would be appreciated. Please direct any questions on this matter to Dr. Susan Ivester Rees at (205) 690-2724 or FTS 537-2724.

Sincerely,

N. D. McClure, IV
Chief, Environment and Resources
Branch

Enclosure

Copy Furnished:

Mr. Larry Goldman, Field Supervisor
U. S. Fish and Wildlife Service

April 5, 1987

Coastal Environment Section

Mr. Paul Raymond
National Marine Fisheries Service
9450 Koger Boulevard
Duval Building
St. Petersburg, Florida 33702

Dear Mr. Raymond:

The U. S. Army Corps of Engineers, Mobile District, is preparing a Draft Environmental Impact Statement for channel improvements at Bayou La Batre, Alabama. A map of the project area is enclosed.

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Sincerely,

N. D. McClure, IV
Chief, Environment and Resources
Branch

Enclosure

Copy Furnished:

Dr. Edwin Keppner
National Marine Fisheries Service

United States Department of the Interior
FISH AND WILDLIFE SERVICE
JACKSON MALL OFFICE CENTER
300 WOODROW WILSON AVENUE, SUITE 316
JACKSON, MISSISSIPPI 39213

April 20, 1987

IN REPLY REFER TO:
Log No. 4-3-87-230

Mr. N. D. McClure
Chief, Environment & Resources Branch
U.S. Army Corps of Engineers
Post Office Box 2288
Mobile, AL 36628-0001

Dear Mr. McClure:

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For further endangered species coordination on this project, please contact Mike Dawson of our staff, telephone 601/965-4900, FTS 490-4900.

We appreciate your participation in the effort to protect endangered species.

Sincerely yours,

James H. Stewart
Acting Field Supervisor
Endangered Species Field Office

cc:
Division of Game and Fish, Montgomery, AL
Field Station, FWS, Daphne, AL

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9450 Koger Boulevard
St. Petersburg, FL 33702

May 1, 1987 F/SER23:DCP

N.D. McClure
Chief, Environment and Resources Branch
Mobile District - COE
P. O. Box 2288
Mobile, AL 36628-0001

Dear Mr. McClure:

In response to your letter of April 8, 1987, enclosed is a list of endangered/threatened species that may occur off the coast of Bayou La Batre, Alabama.

If we can be of further assistance please do not hesitate to contact us.

Sincerely yours,

Charles A. Oravetz

Charles A. Oravetz, Chief
Protected Species Management Branch

Enclosure

Endangered and Threatened Species and Critical Habitats Under NMFS Jurisdiction

Alabama

LISTED SPECIES	Scientific Name	Status	Date Listed
finback whale	*Balaenoptera physalus*	E	12/2/70
humpback whale	*Megaptera novaeangliae*	E	12/2/70
sei whale	*Balaenoptera borealis*	E	12/2/70
green sea turtle	*Chelonia mydas*	Th	7/28/78
Kemp's (Atlantic) ridley sea turtle	*Lepidochelys kempi*	E	12/2/70
leatherback sea turtle	*Dermochelys coriacea*	E	6/2/70
loggerhead sea turtle	*Caretta caretta*	Th	7/28/78

SPECIES PROPOSED FOR LISTING
None

CRITICAL HABITAT
None

CRITICAL HABITAT PROPOSED FOR LISTING
None

September 9, 1988

Coastal Environment Section

Dr. Terry Henwood
Protected Species Management Branch
National Marine Fisheries Service
Southeast Region
9450 Koger Boulevard
St. Petersburg, Florida 33702

Dear Dr. Henwood:

Reference is made to your letter of May 1, 1987, regarding channel improvements for Bayou La Batre, Alabama. Reference is also made to the Draft Feasibility Report and Draft Environmental Impact Statement (DEIS) for navigation improvements at Bayou La Batre, Alabama, transmitted to you July 18, 1988, and to your telephone conversation of September 8, 1988, with Dr. Susan Ivester Rees of my staff concerning this project.

As required under Section 7 of the Endangered Species Act of 1973, as amended, the DEIS constitutes the biological assessment. As indicated in Section 5.4 of the DEIS, we have corcluded that the tentatively selected plan would not affect the continued existence of any endangered or threatened species. We therefore request your concurrence of no impact to species under your jurisdiction.

We appreciate your assistance in helping us protect the nation's resources. Should you have any questions, do not hesitate to contact Dr. Rees at 205/690-2724.

Sincerely,

Hugh A. McClellan
Chief, Environment and
Resources Branch

PD-EC/Rees
PD-EC/Nester
PD-E/McClellan

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9450 Koger Boulevard
St. Petersburg, FL 33702

September 13, 1988 F/SER23:TAH:td

Mr. Hugh A. McClellan
Chief, Environmental and
Resources Branch
Mobile District COE
P.O. Box 2288
Mobile, AL 36628-0001

Dear Mr. McClellan:

This responds to your September 9, 1988, letter regarding proposed channel improvements for Bayou La Batre, Alabama. A Draft Feasibility Report and a Draft Environmental Impact Statement (DEIS) was transmitted pursuant to Section 7 of the Endangered Species Act of 1973 (ESA).

We have reviewed the DEIS and concur with your determination that populations of endangered/threatened species under our purview would not be adversely affected by the proposed action.

This concludes consultation responsibilities under Section 7 of the ESA. However, consultation should be reinitiated if new information reveals impacts of the identified activity that may affect listed species or their critical habitat, a new species is listed, the identified activity is subsequently modified or critical habitat determined that may be affected by the proposed activity.

If you have any questions, please contact Dr. Terry Henwood, Fishery Biologist at FTS 826-3366.

Sincerely yours,

Charles A. Oravetz

Charles A. Oravetz, Chief
Protected Species Management Branch

cc: F/PR2
F/SER1

SECTION D-8

CULTURAL RESOURCE LETTERS

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

March 31, 1988

ALABAMA
HISTORICAL COMMISSION

APR 4 1988

RECEIVED

REPLY TO
ATTENTION OF:

Environmental Resources
Planning Section

Mr. F. Lawerence Oaks
Alabama State Historic Preservation Officer
Alabama Historical Commission
725 Monroe Street
Montgomery, Alabama 36104

Dear Mr. Oaks:

This letter is in reference to the Mobile District, U. S. Army Corps of Engineers proposed improvements to the federal navigation channel at Bayou la Batre, Alabama.

In December 1986, you provided comments on a report of documentary research for the Bayou la Batre project, Enclosure 1. In those comments, you indicated that the proposed channel improvements would not affect significant historic properties. At that time, the only channel alignment under consideration extended from Bayou la Batre southward through Petit Bois Pass into the Gulf of Mexico. Subsequently, an alternate channel alignment that extends from Bayou la Batre southward and connects with the Gulf Intracoastal Waterway in Mississippi Sound is being considered. The locations of the two alternate channels are indicated on Enclosure 2.

The new Gulf Intracoastal Waterway channel alignment was included in the geographical area covered by a literature search that was conducted in 1983 as part of the cultural resources investigation for the Pascagoula Harbor, Mississippi Deepening project. Only three shipwrecks were identified along the Gulf Intracoastal Waterway as a result of this study. All three vessel losses post date 1955.

The comprehensive literature searches conducted for both Bayou la Batre and Pascagoula Harbor failed to produce any evidence of potentially significant submerged cultural resources along the Gulf Intracoastal Waterway. It is our opinion that as with the Petit Bois Pass channel, underwater surveys are not required for the Gulf Intracoastal Waterway channel alignment.

If you agree with the determination, please sign this letter in the space provided below and return it to me within thirty (30) days. Should you require additional information, please contact Ms. Dottie Gibbens at 205/694-4114.

Sincerely,

N. D. McClure IV
Chief, Environment and Resources
Branch

Enclosures

CONCURRENCE:

F. Lawerence Oaks (Date)
Alabama State Historic
Preservation Officer

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

04

March 31, 1988

REPLY TO
ATTENTION OF:

Environmental Resources
Planning Section

Mr. Elbert R. Hilliard
Mississippi State Historic
Preservation Officer
Department of Archives and History
Post Office Box 571
Jackson, Mississippi 39205

Dear Mr. Hilliard:

This letter is in reference to proposed improvements to the Mobile District, U. S. Army Corps of Engineers Bayou la Batre, Alabama channel which will include minor dredging of the Gulf Intracoastal Waterway in the waters of Mississippi Sound south of Jackson County, Mississippi. The Mississippi portion of the project is indicated in red on the attached drawing.

Documentary research conducted as part of an earlier cultural resources reconnaissance for the proposed improvements to Pascagoula Harbor, Mississippi included the Gulf Intracoastal Waterway in Mississippi Sound between the existing Pascagoula Harbor channel and the Alabama/Mississippi boundary. This in-depth literature and archival research revealed the presence of only three shipwrecks in the vicinity of the Gulf Intracoastal Waterway. All three vessel losses occurred after 1950.

It is our opinion that the literature search conducted for Pascagoula Harbor has more than adequately demonstrated the lack of potential for submerged cultural resources along the Gulf Intracoastal Waterway in Mississippi Sound. For this reason, we are seeking your concurrence that underwater surveys along the Gulf Intracoastal Waterway are not warranted.

If you agree with this determination, please sign this letter in the space provided below and return it to me within thirty (30) days. Should you require additional information, please contact Ms. Dottie Gibbens at 205/694-4114.

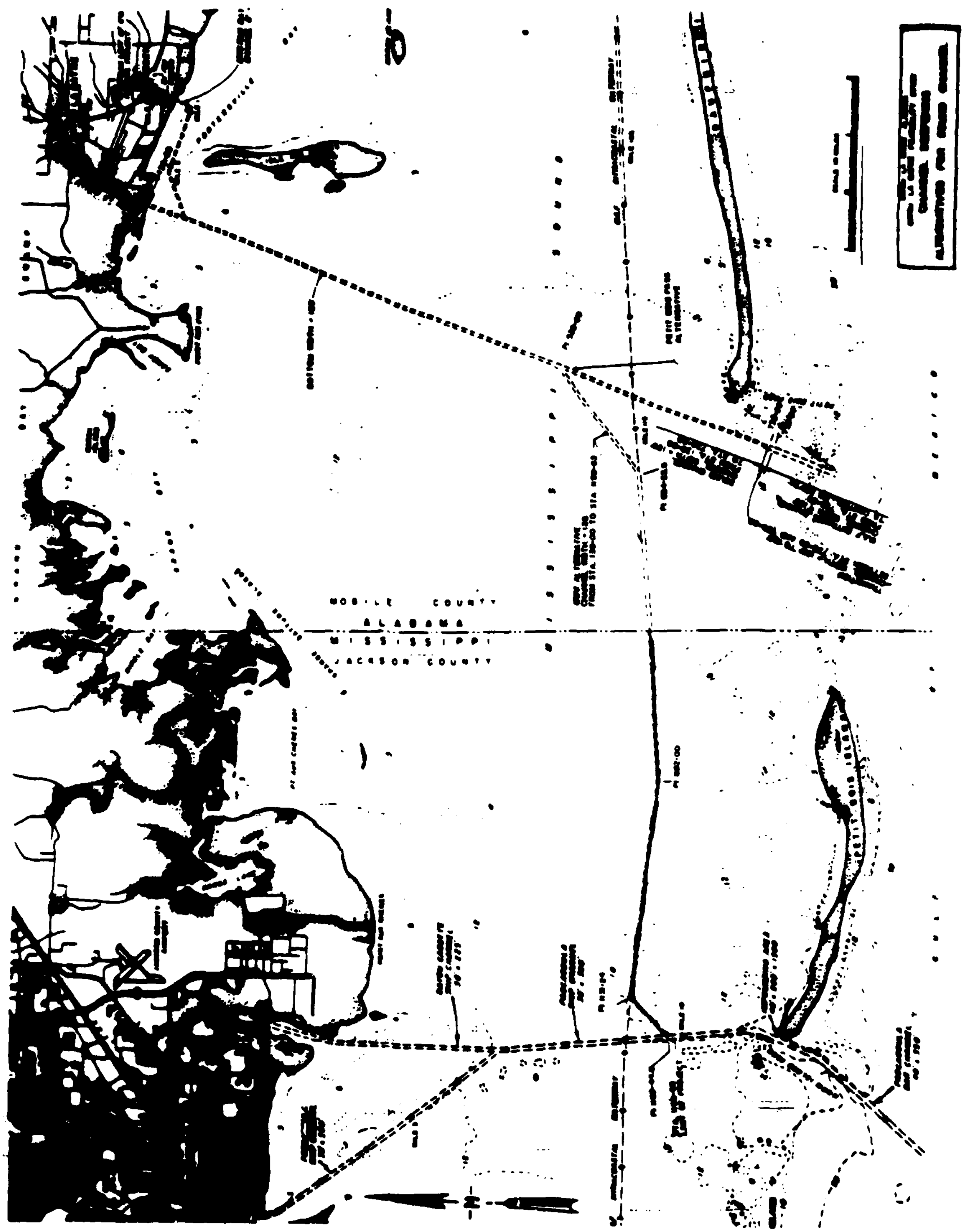
Sincerely,

N. D. McClure IV
Chief, Environment and Resources
Branch

Enclosure

CONCURRENCE:

4-6-88
Elbert R. Hilliard (Date)
Mississippi State Historic
Preservation Officer


MOBILE COUNTY
ALABAMA
MISSISSIPPI
JACKSON COUNTY

STATE OF ALABAMA

ALABAMA HISTORICAL COMMISSION

725 MONROE STREET

MONTGOMERY, ALABAMA 36130-5101

F. LAWERENCE OAKS
EXECUTIVE DIRECTOR

TELEPHONE NUMBER
261 3184

July 1, 1988

John H. Bowen
Acting Chief, Environment and
Resources Branch
Department of the Army
Mobile District, Corps of Engineers
P. O. Box 2288
Mobile, AL 36628-0001

Re: Navigation Channel Improvements
Bayou La Batre, Mobile County, AL

Dear Mr. Bowen:

Upon review of the information forwarded by your office, the Alabama Historical Commission has determined the following. There are four archaeological sites southeast of the project and although the area is not ideally situated, it is our opinion that the potential to locate cultural resources does exist. Therefore, we request that the cultural resource assessment be conducted.

Should you have any questions, please contact our office.

Sincerely,

F. Lawerence Oaks

F. Lawerence Oaks
State Historic Preservation Officer

FLO/GCR/cds

F LAWERENCE OAKS
EXECUTIVE DIRECTOR

STATE OF ALABAMA

ALABAMA HISTORICAL COMMISSION

725 MONROE STREET

MONTGOMERY, ALABAMA 36130-5101

TELEPHONE NUMBER
261-3184

July 27, 1988

Hugh A. McClellan
Acting Chief, Environment and
Resources Branch
Department of the Army
Mobile District, Corps of Engineers
P. O. Box 2288
Mobile, AL 36628-0001

Re: Draft Feasibility Report
and Environmental Impact Statement
for Navigation Improvements at
Bayou La Batre, AL
Mobile County, AL

Dear Mr. McClellan:

Thank you for forwarding the Draft Environmental Impact Statement for our review. As the section on cultural resources states, we concur with the dredging areas. However, we request that a cultural resource assessment be conducted for the spoil deposition area.

Should you have any questions, please contact our office.

Sincerely,

F. Lawerence Oaks

F. Lawerence Oaks
State Historic Preservation Officer

FLO/GCR/cds

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

ALABAMA
HISTORICAL COMMISSION

SEP 13 1988

RECEIVED

September 9, 1988

REPLY TO
ATTENTION OF:

Environmental Resources
Planning Section

Mr. F. Lawerence Oaks
Alabama State Historic Preservation Officer
Alabama Historical Commission
725 Monroe Street
Montgomery, Alabama 36104

Dear Mr. Oaks:

This letter is in reference to the proposed improvements to the federally authorized navigation channel at Bayou La Batre, Alabama. In a letter dated July 27, 1988, you commented on the Draft Feasibility Report and Environmental Impact Statement for this project. In those comments you requested a cultural resources assessment of the proposed upland disposal area.

On September 2, 1988, Mobile District archeologists conducted an inspection of this area. The enclosed Memorandum for Record describes the results of these investigations. As is discussed in the Memorandum, no archeological sites or historic structures were identified within the area.

If you agree with the negative findings of this assessment, please sign this letter in the space provided below and return it to me at your earliest convenience. Should you require additional information, please contact Ms. Dottie Gibbens at 205/694-4114.

Sincerely,

Hugh A. McClellan
Chief, Environment and Resources
Branch

Enclosure

CONCUR: F. Lawerence Oaks

F. Lawerence Oaks (date)
Alabama State Historic Preservation
Officer

APPENDIX E

ENGINEERING DATA AND COST ESTIMATES

FEASIBILITY REPORT
BAYOU La BATRE HARBOR AND CHANNEL
BAYOU La BATRE, ALABAMA

GEOTECHNICAL REPORT

Contents

FEASIBILITY REPORT
BAYOU La BATRE HARBOR AND CHANNEL
BAYOU La BATRE, ALABAMA

GEOTECHNICAL REPORT

General Geology: Bayou La Batre and Mississippi Sound are located in the Gulf Coastal Plain Physiographic Province and are underlain by consolidated and unconsolidated sediments that range in age from Holocene to Miocene. The oldest (Miocene) sediments that outcrop in the coastal area consist of consolidated light gray to varigated and mottled consolidated clays interbedded with sand and gravel zones. The sand and gravel strata contain water under artesian pressure and are a major aquifer in the coastal area. The Miocene section is several hundred to possibly several thousand feet thick. The Pliocene age Citronelle Formation unconformably overlies the Miocene deposits. The Citronelle Formation consists predominantly of reddish brown to orange and yellow gravelly sand. Interspersed in the gravelly sand are lenses and partings of gray, orange and brown sandy clay. The thickness of the Citronelle Formation varies from a few tens of feet in northern Mobile County to possibly 200 feet in the subsurface in the vicinity of Dauphin Island. Semi-consolidated to unconsolidated sediments (sand, silty sand, clay sand and clay) of Pleistocene and Holocene age overlay the Citronelle Formation in Mississippi Sound. These sediments are several tens of feet thick and will constitute the majority of the material encountered during construction of the project.

Previous Investigations: A General Design Memorandum for project modification was prepared in 1966. For the GDM thirty four (34) submarine borings were performed. Borings CD-1 through CD-13 were completed in the harbor channel, and were drilled to depths of 7 to 13 feet below the channel bottom. Borings CD-14 through CD-34 were completed in the Mississippi Sound portion of the channel, and were drilled to depths of 6 1/2 to 11 feet below the channel from the mouth of the harbor to approximately channel station 350+00 (0+00 being the bridge over highway 188). Soil samples retrieved were field classified and presented on logs of borings. Final boring logs and layouts of boring locations were prepared on drawings and bound in the GDM.

Geotechnical Investigation, 1987: Borings completed in 1966 either did not go deep enough or far enough out into the Mississippi Sound to suffice for the proposed improvements of fiscal year '87; therefore, a new geotechnical investigation was undertaken. In the summer of 1987 thirty six (36) vibracore borings were performed. Vibracore consisted of twenty feet of four inch diameter plastic pipe held vertical and vibrated into the in situ soils to retrieve a continuous core sample. Borings VBL-29-87 through VBL-36-87 were completed in the harbor to depths ranging from elevation -27 MLLW to -33 MLLW. Borings VBL-1-87 through VBL-28-87 were completed in the Mississippi Sound portion of the existing channel and outer bar portions of the proposed channel near the west end of Dauphin Island. These borings were drilled to depths reaching between elevation -18.5 MLLW and -41.5 MLLW. Locations of the holes drilled are shown on the boring layout plan, plate 1.

The vibracore tubes, filled with continuous core samples were transported back to the Mobile District's Exploration and Support Section. In the warehouse, three foot long sections were cut from selected tubes and sent with sample cores intact to the lab for determination of the unit weight of the material and other analyses. The remaining tubes were split so that soil samples could be taken at each change of material. These samples were forwarded to the Division Laboratory for tests which included moisture contents, specific gravity, Atterberg limits, sieve analyses, etc. Clays encountered in the split cores were tested with a pocket penetrometer and a torvane shear device to provide indications of the shear strength of the sample. The results of laboratory testing are summarized and presented in tabular form on pages 47 - 49.

Reference: A copy of the article "Soil Analysis and Dredging" by Alf H. Sorensen is available in the District Library for reference. Information presented therein is useful for interpreting the results of the soils investigation of the Bayou La Batre channel as well as other dredging projects. It is published in Dredging and Dredged Material Disposal, by the American Society of Civil Engineers, 345 East 47th Street, New York, NY 10017-2398. (Raymond L. Montgomery and Jamie W. Leach editors). The article is copyrighted material and cannot be included in this report.

Soils of Bayou La Batre Harbor: A generalized soil profile is presented on plates 2 and 3. From the profile it can be seen that the soils consist of inorganic clays of high plasticity (CH), poorly-graded sands (SP), sand-silt mixtures (SM) and sand-clay mixtures (SC). In the harbor the upper 2 to 5 feet of material encountered consisted of very soft, black to dark gray clay (CH). This material has the consistency of grease, a very high percentage of water by weight, and contains organic material in concentrations of 8 to 24% by weight. Most of the material below elevation -18 MLLW in the harbor consists of the higher quality soils (SP), (SP-SM) and (SC). These are sands and sand-silt-clay mixtures. The sand sizes, however, are mostly fine as can be seen in results of seive analyses.

From the start of the project at approximate station minus 15+50 to station 30+00, the maximum excavation proposed is to -16 MLLW. Of this, approximately 80 percent of the material will consist of the grease-like clay mentioned above, which has an in situ density of 75 to 80 pounds per cubic foot. The rest, or 20 percent, will be comprised of the sandy soils; assuming they exist in the side slopes of required new work dredging. These have an average in situ density of 125 to 130 pounds per cubic foot. From station 30+00 to the mouth of the harbor (approximately station 130+00) the maximum project cut will be to elevation -24 MLLW. Approximately 20 percent of that material will be composed of the clay mentioned above; the rest, or 80 percent, will be the sandy soils, also mentioned above.

Petrographic analyses were performed on sand samples from borings VBL-32-87, VBL-34-87 and VBL-35-87. Direct shear tests were performed on two samples, one from boring VBL-32-87 and the other from boring VBL-34-87. The c and phi values obtained were 0 tsf & 29 degrees, and 0 tsf & 38 degrees, respectively (these samples should be considered disturbed since they were obtained by the vibracore method). Results of petrographic analyses, shear tests and other laboratory testing are presented on pages 50 - 98.

Soils of Bayou La Batre Channel, Mouth of Harbor to STA 807+00: From the soil profile it can be seen that the soils consist of inorganic clays of high plasticity (CH), poorly graded sands (SP), sand-clay mixtures (SC),

sand-silt mixtures (SM), and inorganic clays of low to medium plasticity (CL). Sands and sandy mixtures decrease greatly in significance and quantity from the mouth of the harbor to approximately station 425+00. Only clay (CH) was encountered from station 445+00 to approximately 685+00. Sandy material begins to show up on the soil profile again at station 685+00 (8300 feet south of the Gulf Intracoastal Waterway), and increases greatly in significance and quantity to the project controlling depth, i.e. the -23 MLLW contour in the Gulf of Mexico near station 807+00.

Firm to stiff clays were encountered below elevation -18 MLLW between station 243+00 and 365+00, below -20 MLLW between 445+00 and 525+00 and below -22 MLLW between 545+00 and 605+00. Elsewhere clays were soft to very soft and sands were of medium to firm relative density.

Between the mouth of the harbor and STA 440+00 it's estimated that 25 percent of the cut to -24 MLLW will consist of fine grained sandy material having an average in situ density of 125 to 130 pounds per cubic foot. The remainder of the cut, from the mouth of the harbor to station 440+00, or about 75 percent, will be composed of (CH) and (SC) material having in situ densities in the range of 90 to 95 pounds per cubic foot. From station 440+00 to 685+00 approximately 95 percent of the cut to -24 MLLW will be composed of fine grained clayey soils (CH) and (SC) which average 90 to 95 pounds per cubic foot in situ. From 685+00 to 807+00 most, or about 80 percent of the cut will be sandy material averaging 125 to 130 pounds per cubic foot in place. The rest will be (CH) and (SC) materials.

General Summary: All materials encountered can be dredged by hydraulic cutterhead dredge. After removal of 2 to 5 feet of muck in the harbor, good sandy material would be available for use in upland disposal area construction or as fill for other types of construction.

The material to be dredged between the mouth of the harbor and approximately station 685+00 might be useful for island construction, however, the recommendation or basis for this judgement would be risky based solely on available data, partly because of the lack of experience with similar construction in Mississippi Sound.

Sands in the bar and in the gulf portion of the proposed alignment passing the west end of Dauphin Island (STA 665+00 to STA 725+00) could be utilized for beach nourishment. The majority of the sand grains fit in a narrow size range between 0.2 mm and 0.4 mm making the Unified Soil Classification a poorly graded, fine grained sand (SP).

Past experience suggests that the clays within the harbor will not form clay balls during transportation via hydraulic pipeline. The majority of the clay material in the channel outside of the harbor also does not appear to have characteristics that would be conducive to clay ball formation. Such judgement is based on the criteria given in the paragraph 4.1.3 of the reference article "Soil Analysis and Dredging". Only 6 of the 28 borings encountered clays with characteristics similar to those identified by the author as being good for clay ball formation.

For design of bulkheads or piles within the harbor a typical section was developed for guidance in selecting soil strata and soil values, (see page 99). The information presented on the section is very generalized and based on the boring logs and available laboratory information from vibracore borings in the channel only. The information presented is enough for developing a feasible design and cost estimate, but is not intended for use in more advanced design memorandums or plans and specifications.

The suggested side slopes for channel excavation are 1 vertical on horizontal from station minus 15+50 to 62+00, 1V on 5H from station 62+00 t

station 685+00, and 1V on 7H from station 685+00 to the end of the project at about station 807+00. The side slopes suggested are based on an average of existing channel side slopes within Bayou La Batre and other gulf coast channels; slope stability analyses were not performed.

GENERAL NOTES

Boring logs shown on the following sheets shall not be copied or altered.

Groundwater depths or elevations shown on the boring logs represent groundwater encountered on the dates shown. Absence of groundwater data on certain borings implies that no data is available, but does not necessarily mean that groundwater will not be encountered at the locations. Groundwater elevations vary and seepage above the depths or elevations shown can be expected at any time.

While the borings are representative of subsurface conditions at their respective locations and for their respective vertical reaches, local minor variations in characteristics of the subsurface materials of the region are anticipated and, if encountered, such variations will not be considered as differing materially from the description shown with the logs or profiles.

Soils are classified in accordance with the Unified Soil Classification System, Technical Memorandum No. 3-357 dated April 1960 for civil projects and Military Standard 619B dated 12 June 1968 for military projects. Soils are visually classified by the field inspector unless noted otherwise.

Driving resistances (blow counts or N values) are determined with a standard split spoon sampler (1-3/8" I.D.) and a 140-lb driving hammer with a 30" drop unless otherwise noted on the boring logs. N values shown numerically on the logs are the sum of blows for the lower two of three 0.5-foot drives that make up the 1.5-foot Standard Penetration Test, except when refusal occurs. Refusal of the splitspoon is defined as 50 blows in less than a 0.5-foot drive. Refusal is shown on the logs as indicated in the following examples:

50/0.3' - Indicates 50 blows (refusal) at depth 0.3' in the first 0.5-foot drive.

20, 50/0.2' - Indicates 20 blows in the first drive and refusal at depth 0.2' in the second 0.5-foot drive.

20, 85/0.8' - Indicates 20 blows in the first drive, 35 blows in the second drive and refusal (50 blows) at depth 0.3' in the third 0.5-foot drive.

"Max size" of gravel or rock fragments shown on the boring logs represents the maximum size of material recovered in the drive sampler and/or core barrel, or observed from augering. "Max size *" is that size inferred by the field inspector from examination of broken samples, or noted by the driller from the drilling operation. Note that the maximum logged size of gravel or rock fragments is likely to be smaller than the maximum size of the in-place material, especially when the maximum logged size is more than approximately one-half the diameter of the drive sampler or core barrel, or more than one-third the diameter of the auger.

LEGEND

COARSE-GRAINED SOILS - MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE

GW	WELL GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
GP	POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
SW	WELL GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
SM	SILTY SANDS, SAND-SILT MIXTURES
SM-H	SAME AS ABOVE WITH HIGH LIQUID LIMIT
SC	CLAYEY SANDS, SAND-CLAY MIXTURES
SC-H	SAME AS ABOVE WITH HIGH LIQUID LIMIT

FINE-GRAINED SOILS - MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE

ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SANDY SILTS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
OL	ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
PT	PEAT AND OTHER HIGHLY ORGANIC SOILS

NOTES:

NO SAMPLE OR RECOVERY

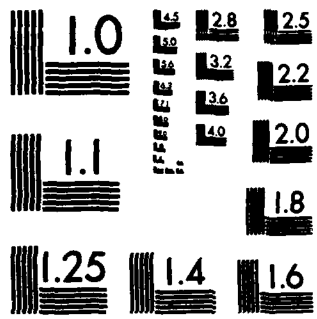
DUAL CLASSIFICATIONS, E.G. SP-SM, GP-GM, ML-CL AND SM-SC, WILL BE SHOWN BY PLACING BOTH SYMBOLS SIDE BY SIDE.

ABBREVIATIONS

@	AT	EST.	ESTIMATE, ESTIMATED
ACCUM.	ACCUMULATED	EXCL.	EXCLUDING
ALT.	ALTERNATING	EXTR.	EXTREMELY
ANG.	ANGULAR		
APPROX.	APPROXIMATE, APPROXIMATELY	F.	FINE, FINELY
ARGIL.	ARGILLACEOUS	Fe	IRON
AUG.	AUGER	FERR.	FERRUGINOUS
AVG.	AVERAGE	FIS.	FISSLE
		FLD.	FILLED
B.A.	BASE OF ALLUVIUM	FM.	FORMATION
BBL.	BARREL	FOLIA.	FOLIATION
BDD.	BED, BEDDED, BEDDING	FOS.	FOSSIL, FOSSILIFEROUS
BDR.	BEDROCK	F.R.	FLUID RETURN
BENT.	BENTONITIC	FRAC.	FRACTURE
BGE.	BEIGE	FRAG.,	
B.I.	BREAKAGE INTERVAL	FRAGS	FRAGMENT (S)
BKY.	BLOCKY	F/T	FISHTAILED
BL.	BLACK, BLACKISH		
BLD.	BOULDER	GEN.	GENERALLY
B.O.H.	BOTTOM OF HOLE	GLAU.	GLAUCONITE, GLAUCONITIC
BR.	BROWN, BROWNISH	GR.	GRAY, GRAYISH
BREC.	BRECCIATED	GRA.	GRAIN, GRAINED
BRK.	BROKEN, BREAKAGE	GRAD.	GRADATIONAL
		GRN.	GREEN, GREENISH
C.	COARSE	GRT.	GROUT
CAL.	CALCITE, CALCAREOUS	GVL.	GRAVEL, GRAVELLY
CARB.	CARBONACEOUS	GYP.	GYPSUM
CAV.	CAVITY	G.W.	GROUNDWATER
CBL.	COBBLE		
C.D.	CORRECTED DEPTH	H/A	HIGH ANGLE
CEM.	CEMENT	H/B	HAMMER BREAK
CHT.	CHERT	HD.	HARD
CIRCLE.	CIRCULATION	HI.	HIGH, HIGHLY
CLY.	CLAYEY	HLD.	HEALED
CMT'D	CEMENTED	HMR.	HAMMER
CNTR.(S)	CONCENTRATION(S)	HOR.	HORIZONTAL
COMP.	COMPACT	HYD.	HYDRAULIC
CONC.	CONCRETE		
CONCR.	CONCRETIONS	INCL.	INCLUDING, INCLUDED
CONGL.	CONGLOMERATE	INDT.	INDURATED
CONT.	CONTINUED	INIT.	INITIAL, INITIALLY
CRM.	CRUMBLY	INTBDD.	INTERBED, INTERBEDDED
CR'D	CRUSHED	INTLAM.	INTERLAMINATED
CTD.	COATED	IRR.	IRREGULAR, IRREGULARLY
d.	DEPTH	JT.'S	JOINT, JOINTS
D.	DENSE	JTD.	JOINTED
D.A.	DRILL ACTION		
DECOM.	DECOMPOSED	L/A	LOW ANGLE
DIAG.	DIAGONAL	LAM.	LAMINA, LAMINE, LAMINATED
DIS.	DISSEMINATED		
DK.	DARK	LAY.	LAYER
DOL.	DOLOMITE, DOLOMITIC	L.C.	LOST CORE
DRL.	DRILLING	L.D.W.	LOST DRILL WATER
DSTG.	DISINTEGRATED	LEA.	LEACHED
D T.	DRILL TIME	LIG.	LIGNITIC
D.W.L.	DRILL WATER LOSS	LIT.	LITTLE
D.W.R.	DRILL WATER RETURN	L.L.	LIQUID LIMIT
		LN., LNS.	LENSE, LENSES
EL.	ELEVATION	LO.	LOOSE
ENC.	ENCOUNTERED	LS.	LIMESTONE

AD-A201 866 FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT FOR NAVIGATION IMPR..(U) CORPS OF ENGINEERS SOUTH ATLANTIC MOBILE AL COASTAL SECTION.. J K GRAHAM ET AL. 5/6

UNCLASSIFIED 12 SEP 88 COESAM/PDFC-88/05 F/G 13/2 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

LT.	LIGHT
MAS.	MASSIVE
MAX.	MAXIMUM
MECH.	MECHANICAL
MED.	MEDIUM
MIC.	MICACEOUS
MIN	MINIMUM
MINR.	MINERALIZED MINERALIZATION
MIX.	MIXTURE
MOD.	MODERATE, MODERATE
MOT.	MOTTLING, MOTTLED
MST.	MOIST
MTL.	MATERIAL
MTX.	MATRIX
N/A	NOT APPLICABLE
N/E	NOT ENCOUNTERED
NOD.	NODULE
N/R	NO RECOVERY
NUM.	NUMEROUS
OB.	OVERBURDEN (UNCLASSIFIED)
OBS.	OBSERVED
OCC.	OCCASIONAL, OCCASIONALLY
OOL.	OOLITE, OOLITIC
OP.	OPEN, OPENED
OR.	ORANGE
ORG.	ORGANIC,
PART.	PARTIALLY
PCS.	PIECES
PETRO.	PETROLEUM,. PETROLIFEROUS
PHOS.	PHOSPHATE, PHOSPHOROUS
P.I.	PLASTICITY INDEX
PIT	PIT, PITTED, PITTING
PKT (S)	POCKET
P.L.	PLASTICITY LIMIT
PLA.	PLATY
PLAS.	PLASTIC
PLN.	PLANE
PNK.	PINK
PR.	POORLY
PRED.	PREDOMINATELY
PRESS.	PRESSURE
PROB.	PROBABLE, PROBABILITY
P.T.	PRESSURE TEST
PTC.	PARTICLES
PTG.	PARTING
PUR.	PURPLE
QTZ.	QUARTZ
QTZE.	QUARTZITE
RBL.	RUBBLE
REC.	RECOVERED
RECEM.	RECEMENTED
RD.	RED, REDDISH
RND.	ROUND, ROUNDED
R.Q.D.	ROCK QUALITY DESIGNATION
RTS.	ROOTS
SAP.	SAPROLITE
SAT.	SATURATED
SCAT.	SCATTEREDLY
SCH (S)	SCHIST (OSE)
SD.	SAND
SDY.	SANDY
SH.	SHALE
SHT.	SHEET
SHY.	SHALY
SI.	SILT
SIS.	SILTSTONE
SIY.	SILTY
SL.	SLIGHT, SLIGHTLY
SLCES.	SILICEOUS
SLICK.	SLICKENSIDE
SML.	SMALL
SO.	SOFT
SOL.	SOLUTION, SOLUTIONED, SOLUTIONING
SPG.	SPECIFIC GRAVITY
SPT.	STANDARD PENETRATION TEST STANDARD SPLITSPOON
SS.	SANDSTONE
ST.	STAIN, STAINED, STAINING
STF.	STIFF
STR.	STRUCTURE
STRG.	STRINGER
STYL.	STYLOLITE, STYLOLITIC
SUR.	SURFACED
TEXT.	TEXTURE
T.F.R.	TOP OF FIRM ROCK
THN.	THIN
THK.	THICK
TI.	TIGHT
TN.	TAN, TANNISH
T.O.R.	TOP OF ROCK
TR.	TRACE
TRP.	TRIPOLI
T.S.R.	TOP OF SOUND ROCK
U.L.	UNACCOUNTABLE LOSS
UNACC.	UNACCOUNTABLE
UNWEA.	UNWEATHERED
V/	VERY
VERT.	VERTICAL
VGY.	VUGGY
W/	WITH
WEA.	WEATHERED
WHT.	WHITE
W/H	WEIGHT OF HAMMER
W.L.	WATER LEVEL
W/R	WEIGHT OF ROD
X-BDD.	CROSS-BEDDED
XL.	CRYSTAL
XLN.	CRYSTALLINE
YEL.	YELLOW

Hole No. VBL-1-87

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: MOB	SHEET 1 OF 1 SHEETS
1. PROJECT: BAYOU LA BATRE CHANNEL STUDY		10. SIZE AND TYPE OF BIT: VIBRACORE	
2. LOCATION: N 177,764 E 255,902		11. DATUM FOR ELEVATION SHOWN: MLLW	
3. DRILLING AGENCY: MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE	
4. HOLE NO.: VBL-1-87		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4	UNDISTURBED
5. NAME OF DRILLER: FULLER C.		14. TOTAL NUMBER CORE BOXES: N/A	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: N/A	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE: STARTED 7-14-87	COMPLETED 7-14-87
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE: -11.4	
9. TOTAL DEPTH OF HOLE: 18.0 (EL. -29.4)		18. TOTAL CORE RECOVERY FOR BORING: N/A %	
		19. SIGNATURE OF INSPECTOR: Donaldson B. Jones	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	M.C. e	BOX OR SAMPLE NO. f	REMARKS g
-11.4	0.0					
			(ML) BLK CLAYEY SILT (VERY SOFT)	219	1	LAB TESTING # CLASS LL PL PI #200 1 (CH) 147 32 115 — Sg = 2.62, L.O.I. = 11.9, MA 2 — — — — —, MA 3 (CH) 90 18 72 75 4 (SC) 33 16 17 — MA
-17.0	5.6					
			(SP) GRAY POORLY GRADED SAND (SILTY) W/ MICA (FIRM)		2	
-21.4	10.0					
			(CH) GRAY FAT CLAY W/ SOME WOOD (SOFT)	56	3	* SAMPLE #3: TORVANE - .19 T.S.F. PENETROMETER - .4 T.S.F.
-25.4	14.0					
			(SC) GRAY CLAYEY SAND W/ RTS (FIRM)	24	4	* SAMPLE #4 TORVANE - .21 T.S.F. PENETROMETER - .85 T.S.F.
-29.4	18.0					BOH

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. | PROJECT: BAYOU LA BATRE CHANNEL STUDY | HOLE NO. VBL-1-87

DRILLING LOG | SOUTH ATLANTIC | MDO | SHEET 1 OF 1 SHEETS

1. PROJECT: BAYOU LA BATRE CHANNEL STUDY

2. LOCATION: N 133,497 E 254,470

3. DRILLING AGENCY: MOBILE DISTRICT

4. HOLE NO.: VBL-2-87

5. NAME OF DRILLER: FULLER C

6. DIRECTION OF HOLE: VERTICAL

9. TOTAL DEPTH OF HOLE: 18.2 (EL. -26.3)

10. SIZE AND TYPE OF BIT: VIBRACORE

11. DATUM FOR ELEVATION SHOWN: MLLW

12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE

13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 6

14. TOTAL NUMBER CORE BOXES: N/A

15. ELEVATION GROUND WATER: N/A

16. DATE HOLE: STARTED 7-14-87 COMPLETED 7-14-87

17. ELEVATION TOP OF HOLE: -8.1

18. TOTAL CORE RECOVERY FOR BORING: N/A %

19. SIGNATURE OF INSPECTOR: Dan [illegible]

ELEVATION	DEPTH	CLASSIFICATION OF MATERIALS	M.C.	BOX OR SAMPLE NO.	REMARKS
-8.1			105	1	
-10.6	2.5	(ML) DK GRAY CLAYEY SILT (VERY SOFT)			
-12.6	4.5	(CL) DK GRAY SILTY CLAY W/ TR WOOD FRAGS (SOFT)	43	2	
-14.9	6.8	(MH) INORGANIC SILT W/ SOME WOOD FRAGS (SOFT)	79	3	
-21.1	13.0	(CH) DK GRAY FAT CLAY W/ SOME WOOD & MICA (SOFT)	47	4	* SAMPLE #4 TORVANE - 0.018 T.S.F. PENETROMETER - 0.25 T.S.F
-23.8	15.7	(SM) DK GRAY SILTY SAND W/ RTS & SOME WOOD & MICA (FIRM)		5	
-26.3	18.2	(SP) DK GRAY POORLY GRADED SAND (SILTY) W/ SOME WOOD (FIRM)		6	BOH

LAB. TESTING

#	CLASS	LL	PL	PI	#200
1	(CH)	–	–	–	63
2	(SC)	–	–	–	37
3	(CH)	–	–	–	–
4	(CH)	50	20	30	94
5	–	–	–	–	–

MA

Hole No. VBL-3-87

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: MOB	SHEET 1 OF 1 SHEETS

1. PROJECT: BAYOU LA BATRE CHANNEL STUDY	10. SIZE AND TYPE OF BIT: VIBRACORE
2. LOCATION: N 128,831 E 252,678	11. DATUM FOR ELEVATION SHOWN: MLLW
3. DRILLING AGENCY: MOBILE DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE
4. HOLE NO.: VBL-3-87	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3, UNDISTURBED —
5. NAME OF DRILLER: FULLER C	14. TOTAL NUMBER CORE BOXES: N/A
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.	15. ELEVATION GROUND WATER: N/A
7. THICKNESS OF OVERBURDEN	16. DATE HOLE: STARTED 7-14-87, COMPLETED 7-14-87
8. DEPTH DRILLED INTO ROCK	17. ELEVATION TOP OF HOLE: -11.6
9. TOTAL DEPTH OF HOLE: 17.2 (EL -28.8)	18. TOTAL CORE RECOVERY FOR BORING: N/A %
	19. SIGNATURE OF INSPECTOR: Douglas B. [illegible]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY / M.C. e	BOX OR SAMPLE NO. f	REMARKS g
-11.6						LAB. TESTING
			(ML) DK GRAY CLAYEY SILT (VERY SOFT)	216	1	# CLASS LL PL PI #200 1 (CH) — — — 95 2 (CL) 40 15 25 82 3 (CH) 95 19 76 — Sg 2.64, MA
-16.1	4.5		(CL) BROWNISH-GRAY SILTY CLAY W/ RTS (SOFT)	52	2	* SAMPLE #2 TORVANE - 0.08 T.S.F PENETROMETER - NO READING
-19.1	7.5		(CH) GRAY FAT CLAY (FIRM)	39	3	* SAMPLE #3 TORVANE - .49 T.S.F PENETROMETER - 0.75 T.S.F
-28.8	17.2					BOH

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PROJECT: BAYOU LA BATRE CHANNEL STUDY

HOLE NO.: VBL-3-87

Hole No. VBL-4-87

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: MDO	SHEET 1 OF 1 SHEETS
1. PROJECT: BAYOU LA BATRE CHANNEL STUDY		10. SIZE AND TYPE OF BIT: VIBRACORE	
2. LOCATION: N 124,135 E 250,954		11. DATUM FOR ELEVATION SHOWN: MLLW	
3. DRILLING AGENCY: MOBILE, AL		12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE	
4. HOLE NO.: VBL-4-87		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: 5	UNDISTURBED: —
5. NAME OF DRILLER: FULLER C		14. TOTAL NUMBER CORE BOXES: N/A	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: N/A	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE: STARTED 7-14-87	COMPLETED 7-14-87
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE: -12.7	
9. TOTAL DEPTH OF HOLE: 16.9 (EL. -29.6)		18. TOTAL CORE RECOVERY FOR BORING: N/A %	
		19. SIGNATURE OF INSPECTOR: [illegible signature]	

ELEVATION (a)	DEPTH (b)	CLASSIFICATION OF MATERIALS (Description) (d)	W.C.	BOX OR SAMPLE NO. (f)	REMARKS (g)
-12.7		(ML) DK GRAY CLAYEY SILT (MUCK) (VERY SOFT)	262	1	LAB. TESTING # CLASS LL PL PI #200 2 (CH) — — — — 3 — — — — — 4 (CL) 40 23 17 81 MA
-17.7	5.0	(CH) LT GRAY FAT CLAY (STIFF)		2	* SAMPLE #2 TORVANE-0.31 T.S.F PENETROMETER-1.0 T.S.F
-19.4	6.7	(SM) LT. GRAY SILTY SAND W/TR. WOOD FRAGS (FIRM)		3	
-22.9	10.2	(ML) GRAY CLAYEY SILT W/SOME WOOD (SOFT)	49	4	* SAMPLE #4 TORVANE-0.18 T.S.F PENETROMETER-0.4 T.S.F
-27.0	14.3	(SP) GRAY POORLY GRADED SAND (FIRM)		5	
-29.6	16.9				BOH

Hole No. VBL-5-87

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: MDO	SHEET 1 OF 1 SHEETS

1. PROJECT: BAYOU LA BATRE CHANNEL STUDY
2. LOCATION (Coordinates or Station): N 119,421 E 249,356
3. DRILLING AGENCY: MOBILE DISTRICT
4. HOLE NO. (As shown on drawing title and file number): VBL-5-87
5. NAME OF DRILLER: FULLER C
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 16.8 (EL.-28.4)
10. SIZE AND TYPE OF BIT: VIBRACORE
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4 / UNDISTURBED
14. TOTAL NUMBER CORE BOXES: N/A
15. ELEVATION GROUND WATER: N/A
16. DATE HOLE: STARTED 7-14-87 / COMPLETED 7-14-87
17. ELEVATION TOP OF HOLE: -11.6
18. TOTAL CORE RECOVERY FOR BORING: N/A %
19. SIGNATURE OF INSPECTOR: Douglas B. Jones

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-11.6						
			(ML) DK GRAY CLAYEY SILT (MED STIFF)		1	* SAMPLE #1 TORVANE-0.01 T.S.F PENETROMETER-0.0 T.S.F
-15.6	4.0					
			(SM) GRAY SILTYSAND (FIRM)	32	2	
-18.2	6.6					
			(MH) LT GRAY INORGANIC CLAYEY SILT (SANDY) (VERY SOFT)	21	3	* SAMPLE #3 TORVANE-0.044 T.S.F PENETROMETER-0.0 T.S.F
-21.3	9.7					
			(SP) LT GRAY POORLY GRADED SAND (SILTY) W/ WOOD (FIRM)		4	
-28.4	16.8					BOH

LAB TESTING

#	CLASS	LL	PL	PI	#200
1	(CH)	68	16	52	58
2	(SM)	—	—	—	—
3	(SP)	—	—	—	4
4	—	—	—	—	—

MA?

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PROJECT: BAYOU LA BATRE CHANNEL STUDY | HOLE NO. VBL-5-87

Hole No. VBL-6-87

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: MDO	SHEET 1 OF 2 SHEETS
1. PROJECT: BAYOU LA BATRE CHANNEL STUDY		10. SIZE AND TYPE OF BIT: VIBRACORE	
2. LOCATION: N 117,566 E 248,563		11. DATUM FOR ELEVATION SHOWN: MLLW	
3. DRILLING AGENCY: MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE	
4. HOLE NO.: VBL-6-87		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3	UNDISTURBED
5. NAME OF DRILLER: FULLER C		14. TOTAL NUMBER CORE BOXES: N/A	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.		15. ELEVATION GROUND WATER: N/A	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE: STARTED 7-14-87	COMPLETED 7-14-87
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE: -12.2	
9. TOTAL DEPTH OF HOLE: 20.2 (EL -32.4)		18. TOTAL CORE RECOVERY FOR BORING: N/A %	
		19. SIGNATURE OF INSPECTOR: Douglas B. Jones	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	M.C.	BOX OR SAMPLE NO. f	REMARKS g
-12.2						
			(ML) GRAY CLAYEY SILT (SOFT)	104	1	* SAMPLE #1 TORVANE - 0.024 T.S.F. PENETROMETER - 0.0 T.S.F.
-17.9	5.7					
			(CL) GRAY SANDY CLAY W/ TR WOOD (FIRM)	31	2	* SAMPLE #2 TORVANE - 0.094 T.S.F. PENETROMETER - 0.25 T.S.F.
-21.2	9.0					
			(CH) GRAY FAT CLAY W/ SILT LENSES & LAYERS (STIFF)	29	3	* SAMPLE 3 TORVANE - 0.40 T.S.F. PENETROMETER - 0.75 T.S.F.
	18					
-32.2	20.0		CONTD			

LAB. TESTING

#	CLASS	LL	PL	PI	#200
1	(CH)	71	17	54	- NA
2	(SC)	—	—	—	40
3	(CH)	—	—	—	66

SAM. #1 Sg = 2.65

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PROJECT: BAYOU LA BATRE CHANNEL STUDY | HOLE NO. VBL-6-87

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE -12.2				Hole No. VBL-6-87
PROJECT BAYOU LA BATRE CHANNEL STUDY		INSTALLATION MDO			SHEET 2 OF 2 SHEETS

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
-32.2	b	c	d	e	f	g
-32.4	20.2		(CH) GRAY FAT CLAY W/SILT LENSES & LAYERS (STIFF)		-	BOH

ENG FORM 1836-A (ER 1110-1-1801) PROJECT BAYOU LA BATRE CHANNEL STUDY HOLE NO. VBL-6-8-

Hole No. VBL-7-87

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION MDO	SHEET 1 OF 1 SHEETS

1. PROJECT: BAYOU LA BATRE CHANNEL STUDY
2. LOCATION (Coordinates or Station): N 115,738 E 247,831
3. DRILLING AGENCY: MOBILE DISTRICT
4. HOLE NO. (As shown on drawing title and file number): VBL-7-87
5. NAME OF DRILLER: FULLER C
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 16.7 (EL. -29.1)
10. SIZE AND TYPE OF BIT: VIBRACORE
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED | UNDISTURBED —
14. TOTAL NUMBER CORE BOXES: N/A
15. ELEVATION GROUND WATER: N/A
16. DATE HOLE: STARTED 7-14-87 COMPLETED 7-14-87
17. ELEVATION TOP OF HOLE: -12.4
18. TOTAL CORE RECOVERY FOR BORING: N/A %
19. SIGNATURE OF INSPECTOR: Donald B. Jones

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY M.C	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-12.4						
-14.0	1.6		(ML) GRAY CLAYEY SILT (VERY SOFT)		1	
			(MH) GRAY ELASTIC SILT (SOFT)	77	2	* SAMPLE #2 TORVANE - 0.002 T.S.F PENETROMETER - 0.1 TSF
-18.0	5.6					
			(ML) DK GRAY CLAYEY SILT SLI. PLASTIC (SOFT)	34	3	* SAMPLE #3 TORVANE - 0.01 T.S.F PENETROMETER - 0.15 T.S.F
					4	* SAMPLE #4 TORVANE - 0.036 T.S.F PENETROMETER - 0.1 T.S.F
-27.3	14.9		(SM) SILTY SAND (POORLY GRADED) (SOFT)		5	
-29.1	16.7					BOH

LAB. TESTING

#	CLASS	LL	PL	PI	#200
1	(CH)	—	—	—	—
2	(CH)	67	18	49	62
3	(SC)	—	—	—	34
4	(CH)	—	—	—	—

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Hole No. VBL-8-87

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: MLO	SHEET 1 OF 1 SHEETS

1. PROJECT: BAYOU LA BATRE CHANNEL STUDY	10. SIZE AND TYPE OF BIT: VIBRACORE
2. LOCATION (Coordinates or Station): N 113,827 E 247,142	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW
3. DRILLING AGENCY: MOBILE DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE
4. HOLE NO. (As shown on drawing title and file number): VBL-8-87	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3; UNDISTURBED
5. NAME OF DRILLER: FULLER C.	14. TOTAL NUMBER CORE BOXES: N/A
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: N/A
	16. DATE HOLE: STARTED 7-14-87; COMPLETED 7-14-87
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE: -12.7
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 18.6 (EL. -31.3)	19. SIGNATURE OF INSPECTOR: Douglas B. Jones

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY M.C. e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-12.7						
			(ML) GRAY CLAYEY SILT (VERY SOFT)	74	1	* SAMPLE #1 TORVANE - 0.028 T.S.F. PENETROMETER - 0.0 T.S.F.
-20.1	7.4					
			(CL) GRAY SILTY CLAY (SOFT)		2	* SAMPLE #2 TORVANE - 0.45 T.S.F. PENETROMETER - 0.25 T.S.F.
-22.4	9.7					
			(SP) LT. GRAY & WHITE POORLY GRADED SAND (FIRM)		3	
-31.3	18.6					BOH

LAB TESTING

#	CLASS	LL	PL	PI	#200	
1	(CH)	59	16	43	—	MA
2	(CH)	—	—	—	—	
3	—	—	—	—	—	MA

Hole No. VBL-9-87

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: MJO	SHEET 1 OF 1 SHEETS
1. PROJECT: BAYOU LA BATRE CHANNEL STUDY		10. SIZE AND TYPE OF BIT: VIBRACORE	
2. LOCATION (Coordinates or Station): N 111,979 E 246,372		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW	
3. DRILLING AGENCY: MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE	
4. HOLE NO. (As shown on drawing title and file number): VBL-9-87		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4; UNDISTURBED	
5. NAME OF DRILLER: FULLER C		14. TOTAL NUMBER CORE BOXES: N/A	
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.		15. ELEVATION GROUND WATER: N/A	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE: STARTED 7-14-87; COMPLETED 7-14-87	
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE: -12.9	
9. TOTAL DEPTH OF HOLE: 18.5 (EL. -31.4)		18. TOTAL CORE RECOVERY FOR BORING: N/A %	
		19. SIGNATURE OF INSPECTOR: Douglas B. Jones	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY M.C	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-12.9				187	1	
-15.2	2.3		(ML) DK GRAY (SILT) MUCK (VERY SOFT)			
				87	2	LAB. TESTING # CLASS LL PL PI #200, 1 (CH) - - - 90, LOI: 11.0 2 (CH) - - - 61 3 (SC) - - - -, MA 4 (CH) - - - 99
-19.2	6.3		(ML) GRAY CLAYEY SILT (SOFT)			
				30	3	
-23.9	11.0		(SC) GRAY & TAN CLAYEY SAND (FIRM)			
				52	4	* SAMPLE #4 TORVANE - 0.40 TSF PENETROMETER - 0.75 T.S.F.
-31.4	18.5		(CH) GRAY FAT CLAY (FIRM)			BOH

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: BAYOU LA BATRE CHANNEL STUDY | HOLE NO. VBL-9-87

Hole No. VBL-10-87

DRILLING LOG	DIVISION S.A.D.	INSTALLATION M.D.O.	SHEET 1 OF 1 SHEETS
1. PROJECT BAYOU LA BATRE; CHANNEL STUDY		10. SIZE AND TYPE OF BIT VIBRACORE TUBE	
2. LOCATION (Coordinates or Station) N 110,093 E 245,670		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW	
3. DRILLING AGENCY M.D.O.		12. MANUFACTURER'S DESIGNATION OF DRILL VIBRACORE	
4. HOLE NO. (As shown on drawing title and file number) VBL-10-87		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 2; UNDISTURBED —	
5. NAME OF DRILLER FULLER		14. TOTAL NUMBER CORE BOXES —	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE: STARTED 7-15-87; COMPLETED 7-15-87	
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE −13.2	
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING N/A %	
9. TOTAL DEPTH OF HOLE 15.6 (EL. −28.8)		19. SIGNATURE OF INSPECTOR BRYANT & JONES D.G.H.	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY OR BOX W.C. e	BOX OR SAMPLE No. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
−13.2	0					LAB. TESTING # CLASS LL PL PI #200 1 (CH) — — — 67 2 (CH) 76 20 56 74
	2		(ML) DARK GRAY CLAYEY SILT (VERY SOFT)			
	4			20	1	* SAMPLE #1 TORVANE-0.014 T.S.F PENETROMETER - 0.0 T.S.F
−20.2	7.0					
	8		(CH) LIGHT GRAY FAT CLAY (STIFF)			
	10			85	2	* SAMPLE #2 TORVANE - 0.46 T.S.F PENETROMETER - 1.8 T.S.F
−28.8	15.6		B.O.H.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT BAYOU LA BATRE; CHANNEL STUDY

HOLE NO. VBL-10-87

Hole No. VBL-11-87

DRILLING LOG	DIVISION SAD	INSTALLATION MDO	SHEET 1 OF 1 SHEETS

1. PROJECT: BAYOU LA BATRE; CHANNEL STUDY
2. LOCATION (Coordinates or Station): N 108,183 E 245,014
3. DRILLING AGENCY: MOBILE DISTRICT
4. HOLE NO. (As shown on drawing title and file number): VBL-11-87
5. NAME OF DRILLER: FULLER
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 13.4' (EL. -26.8)
10. SIZE AND TYPE OF BIT: VIBRACORE TUBE
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 2; UNDISTURBED —
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER
16. DATE HOLE: STARTED 7-15-87; COMPLETED 7-15-87
17. ELEVATION TOP OF HOLE: -13.4
18. TOTAL CORE RECOVERY FOR BORING: N/A %
19. SIGNATURE OF INSPECTOR: BRYANT & JONES D.G.H.

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY OR BOX NO. e W.C.	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-13.4	0					LAB. TESTING # CLASS LL PL PI #200, 1 (CH) 91 23 68 83 2 (CH) — — — 89
	2		(ML) DARK GRAY CLAYEY SILT (VERY SOFT)			
	4			122	1	* SAMPLE #1 TORVANE - 0.012 T.S.F PENETROMETER - 0.0 T.S.F
-20.6	7.2					
	8		(CH) LIGHT GRAY FAT CLAY (STIFF)	25	2	* SAMPLE #2 TORVANE - 0.7 T.S.F PENETROMETER - 1.25 T.S.F
-26.8	13.4		B.O.H.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: BAYOU LA BATRE; CHANNEL STUDY

HOLE NO. VBL-11-87

Hole No. VBL-12-87

DRILLING LOG	DIVISION S.A.D.	INSTALLATION M.D.O.	SHEET 1 OF 1 SHEETS
1. PROJECT BAYOU LA BATRE; CHANNEL STUDY		10. SIZE AND TYPE OF BIT VIBRACORE TUBE	
2. LOCATION (Coordinates or Station) N 106,719 E 244,274		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW	
3. DRILLING AGENCY MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL VIBRACORE	
4. HOLE NO. (As shown on drawing title and file number) VBL-12-87		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN — DISTURBED 2 — UNDISTURBED —	
5. NAME OF DRILLER FULLER		14. TOTAL NUMBER CORE BOXES —	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
		16. DATE HOLE — STARTED 7-15-87 — COMPLETED 7-15-87	
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE -13.7	
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING N/A %	
9. TOTAL DEPTH OF HOLE 16.6 (EL. -30.3)		19. SIGNATURE OF INSPECTOR BRYANT & JONES DGH.	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY W.C. e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-13.7	0		(ML) GRAY CLAYEY SILT (VERY SOFT)			LAB. TESTING # CLASS LL PL PI #200 1 (CH) — — — 78 2 (CH) — — — 98
	6			96	1	
-21.4	7.7		(CH) LIGHT GRAY FAT CLAY (STIFF)			
	13			29	2	* SAMPLE #2 TORVANE- 0.61 T.S.F. PENETROMETER- 1.25 T.S.F.
-30.3	16.6		B.O.H.			

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PROJECT BAYOU LA BATRE; CHANNEL STUDY

HOLE NO. VBL-12-8

Hole No. VBL-13-87

DRILLING LOG | DIVISION: S.A.D. | INSTALLATION: M.D.O. | SHEET 1 OF 1 SHEETS

1. PROJECT: BAYOU LA BATRE, CHANNEL STUDY
2. LOCATION (Coordinates or Station): N 104,415 E 243,710
3. DRILLING AGENCY: MOBILE DRISTRICT
4. HOLE NO. (As shown on drawing title and file number): VBL-13-87
5. NAME OF DRILLER: FULLER
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 15.5' (EL -29.6)
10. SIZE AND TYPE OF BIT: VIBRACORE TUBE
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL: VEBRA CORE
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3 | UNDISTURBED —
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER: N/A
16. DATE HOLE: STARTED 7-15-87 | COMPLETED 7-15-87
17. ELEVATION TOP OF HOLE: -14.1
18. TOTAL CORE RECOVERY FOR BORING: N/A %
19. SIGNATURE OF INSPECTOR: D.G.H. BRYANT & JONES

ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	W.C. (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
-14.1	0					LAB. TESTING # CLASS LL PL PI #200 1 (CH) — — — 80 2 (CH) — — — — 3 (CH) 74 17 57 99
			(ML) GRAY CLAYEY SILT (VERY SOFT)	97	1	* SAMPLE #1 TORVANE - 0.02 T.S.F. PENETROMETER - 0.0 T.S.F.
-22.6	8.5		(CL) GRAY SILTY CLAY (SOFT)		2	* SAMPLE #2 TORVANE - 0.31 T.S.F. PENETROMETER - 0.45 T.S.F.
-24.3	10.2		(CH) BROWN & GRAY FAT CLAY (STIFF)	28	3	* SAMPLE #3 TORVANE - 0.70 T.S.F. PENETROMETER - 1.25 T.S.F.
-29.6	15.5		B.O.H.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: BAYOU LA BATRE, CHANNEL STUDY | HOLE NO. VBL-13-87

Hole No. VBL-14-87

DRILLING LOG	DIVISION S.A.D.	INSTALLATION M.D.O.	SHEET 1 OF 1 SHEETS

1. PROJECT: BAYOU LA. BATRE: CHANNEL STUDY	10. SIZE AND TYPE OF BIT: VIBRACORE TUBE
2. LOCATION (Coordinates or Station): N 102,556 E 242,973	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW
3. DRILLING AGENCY: MOBILE DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRA CORE
4. HOLE NO. (As shown on drawing title and file number): VBL-14-87	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 2; UNDISTURBED —
5. NAME OF DRILLER: FULLER	14. TOTAL NUMBER CORE BOXES: —
6. DIRECTION OF HOLE: ■ VERTICAL □ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: N/A
7. THICKNESS OF OVERBURDEN	16. DATE HOLE: STARTED 7-15-87; COMPLETED 7-15-87
8. DEPTH DRILLED INTO ROCK	17. ELEVATION TOP OF HOLE: -14.0
9. TOTAL DEPTH OF HOLE: 13.5 (EL. -27.5)	18. TOTAL CORE RECOVERY FOR BORING: N/A %
	19. SIGNATURE OF INSPECTOR: BRYANT & JONES — D.G.H.

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY (W.C.) e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-14.0	0					
	0–6.8		(ML) DARK GRAY CLAYEY SILT (VERY SOFT)			LAB. TESTING # CLASS LL PL PI #200 1 (CH) 77 20 57 70 2 (CH) — — — —
	~5.5			87	1	* SAMPLE # 1 TORVANE - 0.012 TSF PENETROMETER - 0.0 T.S.F.
-20.8	6.8		(CH) LIGHT GRAY FAT CLAY (STIFF)			
	~12			35	2	* SAMPLE # 2 TORVANE - 0.7 TSF PENETROMETER - 1.25 TSF
-27.5	13.5		B.O.H.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: BAYOU LA BATRE CHANNEL STUDY

HOLE NO.: VBL-14-8[illegible]

Hole No. VBL-15-87

DRILLING LOG	DIVISION S.A.D	INSTALLATION M.D.O.	SHEET 1 OF 1 SHEETS
1. PROJECT BAYOU LA BATRE, CHANNEL STUDY		10. SIZE AND TYPE OF BIT VIBRACORE TUBE	
2. LOCATION (Coordinates or Station) N 100,735 E 242,196		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW	
3. DRILLING AGENCY MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL VIBRACORE	
4. HOLE NO. (As shown on drawing title and file number) VBL-15-87		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3-TUBE, 1-JAR; UNDISTURBED —	
5. NAME OF DRILLER C. FULLER		14. TOTAL NUMBER CORE BOXES —	
6. DIRECTION OF HOLE: ■ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE: STARTED 7-15-87; COMPLETED 7-15-87	
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE -14.0	
9. TOTAL DEPTH OF HOLE 15.0 (EL. -29.0)		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR BRYANT & JONES D.G.H.	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	W.C	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-14.0	0		* (ML) DARK GRAY CLAYEY SILT *VISUAL CLASSIFICATION MADE WHILE SOILS SAMPLES WERE SEALED IN CLEAR VIBRACORE TUBE.	164	1*	* SAMPLES 1,2 & 3 WERE CUT, SEALED & SENT TO S.A.D. LAB IN VIBRACORE SAMPLING TUBE.
	3			98	2*	
	6			81	3*	LAB. TESTING * CLASS LL PL PI #200 1*(CH) — — — 97 2*(CH) 79 20 59 L.O.I. = 11.6, M.A. Sg = 2.70 γd = 40.3
-23.0	9		(CH) GRAY FAT CLAY (STIFF)	27	1**	** JAR SAMPLE JAR SAMPLE #1 - TORVANE - 0.68 T.S.F. PENETROMETER - 1.2 T.S.F.
	12					
-29.0	15		B.O.H			

LABORATORY TESTING
Visual Classification and/or Remarks

SAM #	
1*	Dark gray fat clay (CH), with organic material, very wet, and trace of sand
2*	Dark gray fat clay (CH), with organic material, very wet, and trace of sand
3*	6.0-8.0' depth Dark gray fat clay (CH), with organic material, very wet, with trace of sand.
	8.0-9.0 depth Red and brown fat clay (CH), w/trace of sand, firm.

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT BAYOU LA BATRE; CHANNEL STUDY HOLE NO. VBL-15-87

Hole No. VBL-16-87

DRILLING LOG	DIVISION S.A.D	INSTALLATION M.D.O.	SHEET 1 OF 1 SHEETS

1. PROJECT: BAYOU LA BATRE; CHANNEL STUDY	10. SIZE AND TYPE OF BIT: VIBRACORE TUBE
2. LOCATION (Coordinates or Station): N 93,844 E 241,548	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW
3. DRILLING AGENCY: MOBILE DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE
4. HOLE NO. (As shown on drawing title and file number): VBL-16-87	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1; UNDISTURBED —
5. NAME OF DRILLER: C. FULLER	14. TOTAL NUMBER CORE BOXES: N/A
6. DIRECTION OF HOLE: ■ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: N/A
	16. DATE HOLE: STARTED 7-15-87; COMPLETED 7-15-87
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE: -13.9
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 11.4' (EL. -25.3)	19. SIGNATURE OF INSPECTOR: BRYANT & JONES D.G.H.

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY or BOX W.C.	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-13.9	0					
	2					LAB. TESTING # CLASS LL PL PI #200 1 (CH) 65 16 49 60
	4		(ML) DARK GRAY CLAYEY SILT (SOFT)			
	6					
				73	1	* SAMPLE # 1: TORVANE - 0.066 T.S.F. PENETROMETER 0.35 T.S.F.
	8					
	10					
-25.3	11.4		B.O.H.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: BAYOU LA BATRE, CHANNEL STUDY — HOLE NO. VBL-16-87

Hole No. VBL-17-87

DRILLING LOG	DIVISION SAD	INSTALLATION M.D.O.	SHEET 1 OF 1 SHEETS

1. PROJECT BAYOU LA BATRE; CHANNEL STUDY	10. SIZE AND TYPE OF BIT VIBRACORE TUBE
2. LOCATION (Coordinates or Station) N 96,975 E 240,877	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW
3. DRILLING AGENCY MOBILE DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL VIBRACORE
4. HOLE NO. (As shown on drawing title and file number) VBL.-17-87	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN — DISTURBED 2 — UNDISTURBED —
5. NAME OF DRILLER C. FULLER	14. TOTAL NUMBER CORE BOXES —
6. DIRECTION OF HOLE [x] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER N/A
	16. DATE HOLE — STARTED 7-15-87 — COMPLETED 7-15-87
	17. ELEVATION TOP OF HOLE -13.9
7. THICKNESS OF OVERBURDEN	18. TOTAL CORE RECOVERY FOR BORING N/A %
8. DEPTH DRILLED INTO ROCK	19. SIGNATURE OF INSPECTOR BRYANT & JONES D.G.H.
9. TOTAL DEPTH OF HOLE 12.9 (EL -26.8)	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e (W.C.)	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-13.9	0		(ML) DARK GRAY CLAYEY SILT (VERY SOFT)			LAB TESTING # CLASS LL PL PI #200 1 (CH) — — — 76 2 (CH) — — — 99
	6			98	1	*SAMPLE #1: TORVANE-0.024 T.S.F. PENETROMETER-0.0 T.S.F.
-22.2	8.3		(CH) LIGHT GRAY FAT CLAY (FIRM)			
				41	2	*SAMPLE #2: TORVANE-0.33 T.S.F. PENETROMETER-0.5 T.S.F.
-26.8	12.9		B.O.H.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT BAYOU LA BATRE; CHANNEL STUDY HOLE NO. VBL-17-87

Hole No. VBL-18-87

DRILLING LOG	DIVISION S.A.D.
INSTALLATION M.D.O.	SHEET 1 OF 1 SHEETS
1. PROJECT BAYOU LA BATRE; CHANNEL STUDY	10. SIZE AND TYPE OF BIT VIBRACORE TUBE
2. LOCATION (Coordinates or Station) N 95,063 E 240,187	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW
3. DRILLING AGENCY MOBILE DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL VIBRACORE
4. HOLE NO. (As shown on drawing title and file number) VBL-18-87	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 3; UNDISTURBED —
5. NAME OF DRILLER C. FULLER	14. TOTAL NUMBER CORE BOXES —
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER N/A
	16. DATE HOLE: STARTED 7-15-87; COMPLETED 7-15-87
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE -14.1
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 16.3' (EL. -30.4)	19. SIGNATURE OF INSPECTOR BRYANT & JONES D.G.H.

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY OR W.C. e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-14.1	0		(ML) DARK GRAY CLAYEY SILT (VERY SOFT)	95		* SAMPLE #1: TORVANE-0.012 TSF PENETROMETER - 0.0 TSF
-22.6	8.5		(CL) LIGHT GRAY SILTY CLAY (FIRM)	21	2	* SAMPLE #2 TORVANE-0.35 TSF PENETROMETER - 0.75 TSF
-26.1	12		(CH) LIGHT GRAY FAT CLAY (STIFF)	33	3	* SAMPLE #3: TORVANE: 0.62 TSF PENETROMETER: 1.25 TSF
-30.4	16.3		B.O.H.			

LAB. TESTING

#	CLASS	LL	PL	PI	#200
1	(CH)	—	—	—	76
2	(CH)	—	—	—	98
3	(CH)	—	—	—	99

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT BAYOU LA BATRE; CHANNEL STUDY

HOLE NO. VBL-18-87

Hole No. VBL-19-87

DRILLING LOG	DIVISION S.A.D.	INSTALLATION M.D.O.	SHEET 1 OF 1 SHEETS
1. PROJECT BAYOU LA BATRE; CHANNEL STUDY		10. SIZE AND TYPE OF BIT VIBRACORE TUBE	
2. LOCATION (Coordinates or Station) N 93,207 E 239,355		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW	
3. DRILLING AGENCY		12. MANUFACTURER'S DESIGNATION OF DRILL VIBRACORE	
4. HOLE NO. (As shown on drawing title and file number) VBL-19-87		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 5; UNDISTURBED —	
5. NAME OF DRILLER C. FULLER		14. TOTAL NUMBER CORE BOXES —	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
		16. DATE HOLE: STARTED 7-15-87; COMPLETED 7-15-87	
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE -13.8	
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING N/A %	
9. TOTAL DEPTH OF HOLE 17.2' (EL. -31.0)		19. SIGNATURE OF INSPECTOR BRYANT & JONES D.G.H.	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	W.C.	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-13.8	0		(ML) GRAY CLAYEY SILT (VERY SOFT)	170	1	LAB. TESTING #CLASS LL PL PI #200, 1 (CH) — — — — 2 (CH) — — — 67 3 (CL) 37 14 23 86, SG= 2.67 4 (CH) — — — — 5 (CH) — — — —
				79	2	* SAMPLE #2 TORVANE-0.092 T.S.F PENETROMETER- 0.0 T.S.F
-23.0	9.2		(CH) GRAY FAT CLAY (SOFT TO STIFF)	29	3	* SAMPLE #3 TORVANE-0.14 T.S.F PENETROMETER- 0.25 T.S.F
				30	4	* SAMPLE #4 TORVANE-0.51 T.S.F PENETROMETER- 1.3 T.S.F
-26.1	12.3		(ML) LIGHT GRAY SANDY SILT (CLAYEY) (VERY SOFT)	24	5	* SAMPLE #5 TORVANE-0.29 T.S.F PENETROMETER- 0.0 T.S.F
-31.0	17.2		B.O.H			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT BAYOU LA BATRE; CHANNEL STUDY | HOLE NO. VBL-19-87

Hole No. VBL-20-87

DRILLING LOG	DIVISION S.A.D.	INSTALLATION M.D.O	SHEET 1 OF 1 SHEETS

1. PROJECT BAYOU LA BATRE; CHANNEL STUDY	10. SIZE AND TYPE OF BIT VIBRACORE TUBE
2. LOCATION (Coordinates or Station) N 91,344 E 238,784	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW
3. DRILLING AGENCY MOBILE DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL VIBRACORE
4. HOLE NO. (As shown on drawing title and file number) VBL-20-87	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4; UNDISTURBED —
5. NAME OF DRILLER C. FULLER	14. TOTAL NUMBER CORE BOXES —
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER N/A
	16. DATE HOLE STARTED 7-15-87 COMPLETED 7-15-87
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE −14.2
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 11.6 (EL. −25.8)	19. SIGNATURE OF INSPECTOR BRYANT & JONES DGH

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
−14.2			(ML) GRAY CLAYEY SILT (SOFT)	92	1	
	2		W/SHELL FRAGS		2	*SAMPLE #2 TORVANE - 0.06 TSF PENETROMETER - 0.2 TSF
	4					LAB. TESTING
	6					# CLASS LL PL PI #200 1 (CH) — — — — 2 (CH) — — — — 3 (CH) — — — — 4 (SM) — — — —
−21.2	7		(CH) LIGHT GRAY FAT CLAY (STIFF)		3	*SAMPLE #3 TORVANE - 0.55 TSF PENETROMETER - 1.7 TSF
−22.7	8.5		(SM) LIGHT GRAY SILTY SAND (FIRM)			
	10				4	
−25.8	11.6		BOH			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT BAYOU LA BATRE; CHANNEL STUDY | HOLE NO. VBL-20-87

Hole No. VBL-21-87

DRILLING LOG	DIVISION: S.A.D.	INSTALLATION: M.D.O.	SHEET 1 OF 1 SHEETS

1. PROJECT: BAYOU LA BATRE; CHANNEL STUDY	10. SIZE AND TYPE OF BIT: VIBRACORE TUBE
2. LOCATION (Coordinates or Station): N 89,450 E 238,043	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW
3. DRILLING AGENCY: MOBILE DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE
4. HOLE NO. (As shown on drawing title and file number): VBL-21-87	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3; UNDISTURBED —
5. NAME OF DRILLER: C. FULLER	14. TOTAL NUMBER CORE BOXES: —
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: N/A
	16. DATE HOLE: STARTED 7-15-87; COMPLETED 7-15-87
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE: -14.7
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 15.4 (EL. -30.1)	19. SIGNATURE OF INSPECTOR: BRYANT & JONES D.G.H

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-14.7	0		(ML) DARK GRAY CLAYEY SILT W/TR SHELL FRAGS. (VERY SOFT)	87	1	* SAMPLE #1 TORVANE - 0.018 T.S.F. PENETROMETER - 0.0 T.S.F
						LAB. TESTING
				114	2	* SAMPLE #2: TORVANE - 0.05 T.S.F. PENETROMETER - 0.0 T.S.F
-25.9	11.2		(CH) GRAY FAT CLAY (SOFT)		3	* SAMPLE #3 TORVANE - 0.1 T.S.F PENETROMETER - 0.25 T.S.F
-30.1	15.4		B.O.H.			

LAB. TESTING

#	CLASS	LL	PL	PI	#200
1	(CH)	—	—	—	—
2	(CH)	—	—	—	86
3	(CH)	—	—	—	—

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: BAYOU LA BATRE; CHANNEL STUDY — HOLE NO. VBL-21-87

Hole No. VBL-22-87

DRILLING LOG	DIVISION S.A.D.	INSTALLATION M.D.O.	SHEET 1 OF 1 SHEETS

1. PROJECT: BAYOU LA BATRE; CHANNEL STUDY	10. SIZE AND TYPE OF BIT: VIBRACORE TUBE
2. LOCATION (Coordinates or Station): N 87,590 E 237,466	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW
3. DRILLING AGENCY: MOBILE DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE
4. HOLE NO. (As shown on drawing title and file number): VBL-22-87	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3-TUBE, 1-JAR; UNDISTURBED —
5. NAME OF DRILLER: FULLER	14. TOTAL NUMBER CORE BOXES —
6. DIRECTION OF HOLE: ■ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: N/A
	16. DATE HOLE: STARTED 7-16-87; COMPLETED 7-16-87
	17. ELEVATION TOP OF HOLE: -15.8
7. THICKNESS OF OVERBURDEN	18. TOTAL CORE RECOVERY FOR BORING: N/A %
8. DEPTH DRILLED INTO ROCK	19. SIGNATURE OF INSPECTOR: BRYANT & JONES DGH
9. TOTAL DEPTH OF HOLE: 13.4' (EL. -29.2)	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-15.8	0		*(ML) DARK GRAY CLAYEY SILT * VISUAL CLASSIFICATION MADE WHILE SOILS SAMPLES WERE SEALED IN CLEAR VIBRACORE TUBE	99	1*	* SAMPLES 1,2 & 3 WERE CUT, SEALED & SENT TO S.A.D. LAB IN VIBRACORE SAMPLING TUBES
	3				2*	
	6				3*	LAB. TESTING ** CLASS LL PL PI #200 1*(CH) - - - 79, 1*(CH) 67 15 52 MA, Sg=2.65 Bd.=58.6 2*(SC) - - - 37, 3*(SC)&(CH) — 48,
-24.8	9		(SC) GRAY & LT. GRAY CLAYEY SAND (SILTY) (STIFF)	22	1**	** JAR SAMPLE JAR SAMPLE #1: TORVANE-0.45 TSF PENETROMETER-1.0 TSF
	12					
-29.2	13.4		B.O.H.			

SAM. #	DEPTH	LAB. TESTING Visual Classification and/or Remarks
1*	0.0-2.0	Dark gray soft fat clay (CH), with trace of sand
	2.0-3.0	Gray soft, silty sand (SM), slightly plastic fines and trace of shell.
2*	3.0-4.8	Dark gray soft clayey sand (SC), with trace of shell
	4.8-4.9	Wood.
	4.9 - 6.0	Dark gray soft clayey sand (SC).
3*	6.0-8.8	Dark gray soft clayey sand (SC), with trace of shell
	8.8-9.0	Brown soft fat clay (CH), with trace of sand

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT: BAYOU LA BATRE. CHANNEL STUDY HOLE NO. VBL-22-8

Hole No. VBL-23-87

DRILLING LOG	DIVISION S.A.D.	INSTALLATION M.D.O.	SHEET 1 OF 1 SHEETS

1. PROJECT BAYOU LA BATRE; CHANNEL STUDY	10. SIZE AND TYPE OF BIT VIBRACORE TUBE
2. LOCATION (Coordinates or Station) N 85,601 E 236,588	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW
3. DRILLING AGENCY MOBILE DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL VIBRACORE
4. HOLE NO. (As shown on drawing title and file number) VBL-23-87	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3; UNDISTURBED —
5. NAME OF DRILLER C. FULLER	14. TOTAL NUMBER CORE BOXES —
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 7-16-87; COMPLETED 7-16-87
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE -13.8
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 12.1' (EL. -25.9)	19. SIGNATURE OF INSPECTOR BRYANT & JONES C.G.H

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e W.C	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-13.8	0		(SP) LIGHT TAN POORLY GRADED SAND W/TRACE SHELL FRAGS (FIRM)		1	LAB. TESTING #CLASS LL PL PI #200 1 (SP) - - - - MA 2 (CH) 86 26 60 78 3 (CH) - - - -
-18.8	5		(CL) GRAY SILTY CLAY (VERY SOFT)	91	2	* SAMPLE #2 TORVANE - 0.052 TSF PENETROMETER - 0.0 T.S.F
-23.9	10.1		(CH) RED & GRAY FAT CLAY (STIFF)		3	* SAMPLE #3 TORVANE - 0.68 TSF PENETROMETER - 1.0 T.S.F
-25.9	12.1		B.O.H.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT BAYOU LA BATRE CHANNEL STUDY

HOLE NO. VBL-23-87

Hole No. VBL-24-87

DRILLING LOG	DIVISION S.A.D.	INSTALLATION M.D.O.	SHEET 1 OF 1 SHEETS

1. PROJECT BAYOU LA BATRE ; CHANNEL STUDY	10. SIZE AND TYPE OF BIT VIBRACORE TUBE
2. LOCATION (Coordinates or Station) N 83, 858 E 235, 997	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW
3. DRILLING AGENCY MOBILE DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL VIBRACORE
4. HOLE NO. (As shown on drawing title and file number) VBL-24-87	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED 3 — UNDISTURBED —
5. NAME OF DRILLER FULLER	14. TOTAL NUMBER CORE BOXES —
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE STARTED 7-16-87 COMPLETED 7-16-87
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE -13.4
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 15.3' (EL. -28.7)	19. SIGNATURE OF INSPECTOR BRYANT & JONES D.G.H.

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY W.C e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-13.4	0 – 7.8		(SP) GRAY POORLY GRADED SAND (SILTY) W/ SHELL FRAGS (FIRM)		1	LAB TESTING * CLASS LL PL PI #200, 1 — — — — —, MA 2 (SM) — — — 18, 3 (CH) — — — —,
-21.2	7.8 – 10.5		(SC) GRAY CLAYEY SAND (SOFT)	34	2	* SAMPLE #2 TORVANE - 0.05 TSF PENETROMETER - 0.0 TSF
-23.9	10.5 – 15.3		(CH) GRAY FAT CLAY (SOFT)		3	* SAMPLE #3 TORVANE - 0.18 TSF PENETROMETER - 0.25 T.S.F
-28.7	15.3		B.O.H.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT BAYOU LA BATRE ; CHANNEL STUDY

HOLE NO. VBL-24-87

Hole No. VBL-25-87

DRILLING LOG	DIVISION S.A.D.	INSTALLATION M.D.O.	SHEET 1 OF 1 SHEETS

1. PROJECT BAYOU LA BATRE; CHANNEL STUDY	10. SIZE AND TYPE OF BIT VIBRACORE TUBE
2. LOCATION (Coordinates or Station) N 82,129 E 235,386	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW
3. DRILLING AGENCY MOBILE DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL VIBRACORE
4. HOLE NO. (As shown on drawing title and file number) VBL-25-87	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 2; UNDISTURBED —
5. NAME OF DRILLER FULLER	14. TOTAL NUMBER CORE BOXES —
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER N/A
	16. DATE HOLE: STARTED 7-16-87; COMPLETED 7-16-87
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE -10.4
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 12.2' (EL. -22.6)	19. SIGNATURE OF INSPECTOR BRYANT & JONES D.G.H.

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e W.C	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-10.4	0		(SP) BEIGE POORLY GRADED SAND (FIRM)		1	LAB TESTING #CLASS LL PL PI #200 1 (SP) — — — —, MA 2 (CH) 77 20 57 64,
-16.4	6		(CL) GRAY SILTY CLAY W/ SOME SHELL FRAGS. (VERY SOFT)	73	2	* SAMPLE #2 TORVANE-0.069 T.S.F. PENETROMETER- 0.0 T.S.F.
-22.6	12.2		B.O.H.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT BAYOU LA BATRE: CHANNEL STUDY | HOLE NO. VBL-25-8

Hole No. VBL-26-87

DRILLING LOG	DIVISION S.A.D.	INSTALLATION M.D.O.	SHEET 1 OF 1 SHEETS

1. PROJECT: BAYOU LA BATRE; CHANNEL STUDY
2. LOCATION (Coordinates or Station): N 30,155 E 234,624
3. DRILLING AGENCY: MOBILE DISTRICT
4. HOLE NO. (As shown on drawing title and file number): VBL-26-87
5. NAME OF DRILLER: FULLER
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 8.5' (EL. -18.4)
10. SIZE AND TYPE OF BIT: VIBRACORE TUBE
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1 | UNDISTURBED —
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER
16. DATE HOLE: STARTED 7-16-87 | COMPLETED 7-16-87
17. ELEVATION TOP OF HOLE: -9.9
18. TOTAL CORE RECOVERY FOR BORING: N/A %
19. SIGNATURE OF INSPECTOR: BRYANT & JONES D.G.H.

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY OR W.C. e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-9.9	0					
	2		(SP) LIGHT GRAY POORLY GRADED SAND W/ TRACE SHELL FRAGS. (FIRM)			
	4					LAB. TESTING # CLASS LL PL PI #200 1 (SP) - - - - MA
					1	
	6					
-18.4	8.5					
			B.O.H.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT: BAYOU LA BATRE; CHANNEL STUDY HOLE NO. VBL-26-8

Hole No. VBL-27-87

DRILLING LOG	DIVISION S.A.D.	INSTALLATION M.D.O.	SHEET 1 OF 2 SHEETS

1. PROJECT: BAYOU LA BATRE; CHANNEL STUDY
2. LOCATION (Coordinates or Station): N 78,223 E 233,844
3. DRILLING AGENCY: MOBILE DISTRICT
4. HOLE NO. (As shown on drawing title and file number): VBL-27-87
5. NAME OF DRILLER: C. FULLER
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 17.2' (EL. -24.4)
10. SIZE AND TYPE OF BIT: VIBRACORE TUBE
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 4-TUBE, 2-JAR; UNDISTURBED —
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER
16. DATE HOLE: STARTED 7-16-87; COMPLETED 7-16-87
17. ELEVATION TOP OF HOLE: -7.2
18. TOTAL CORE RECOVERY FOR BORING: N/A %
19. SIGNATURE OF INSPECTOR: BRYANT & JONES D.G.H.

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY W.C e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-7.2	0		(SP) GRAY POORLY GRADED SAND		1*	* SAMPLES 1,2,3 & 4 WERE CUT, SEALED & SENT TO S.A.D. LAB IN VIBRACORE SAMPLING TUBE.
	3			18	2*	
	6		*VISUAL CLASSIFICATION (@ 0.0' TO 12.0') WERE MADE WHILE SOILS SAMPLES WERE SEALED IN CLEAR VIBRACORE TUBES	17	3*	LAB. TESTING # CLASS LL PL PI #200 1# (SP-SM) — — — — 2# (CH) 85 22 63 67
	9		POORLY GRADED SAND (SILTY)		4*	1* (SP) NP NP NP - MA 2* (SP) NP NP NP - MA Sg = 2.62, γd = 105.4 3* (SP) NP NP NP - MA, γd = 106.2 4* (SEE SHT. 2)
-19.2	12		(SP) GRAY POORLY GRADED SAND (SILTY) W/TR. SHELL FRAGS. (FIRM)		1**	** JAR SAMPLES
-20.9	13.7		(CH) DARK GRAY FAT CLAY (VERY SOFT)	60	2**	JAR SAMPLE #2 TORVANE - 0.10 T.S.F. PENETROMETER - 0.0 T.S.F.
-24.4	17.2		B.O.H.			

LAB. TESTING
Visual Classification and/or Remarks

SAM. #	
1*	Gray poorly graded sand (SP) with trace of shell fragments
2*	Gray poorly graded sand (SP) with trace of shell fragments
3*	Gray poorly graded sand (SP) with trace of shell fragments

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT BAYOU LA BATRE: CHANNEL STUDY HOLE NO. VBL-27-87

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE -7.2	Hole No. VBL-27-87
PROJECT BAYOU LA BATRE CHANNEL STUDY	INSTALLATION MDO	SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			LAB TESTING CONT.			

SAM. #	DEPTH	LAB. TESTING Visual Classification and/or Remarks
4*	9.0-10.0	Gray poorly graded sand (SP)
	10.0-10.2	Clay Pocket of fat clay (CH)
	10.2-11.6	Gray poorly graded sand (SP),
	11.6-12.0	Slightly disturbed gray poorly graded sand (SP), with large shells, gravel size.

ENG FORM 1836-A (ER 1110-1-1801) GPO 1980 OF-626-603 PROJECT BAYOU LA BATRE CHANNEL STUDY HOLE NO. VBL-27-87

Hole No. VBL-28-87

DRILLING LOG	DIVISION S.A.D	INSTALLATION M.D.O.	SHEET 1 OF 1 SHEETS

1. PROJECT BAYOU LA BATRE; CHANNEL STUDY	10. SIZE AND TYPE OF BIT VIBRACORE TUBE
2. LOCATION (Coordinates or Station) N 76,411 E 233,152	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW
3. DRILLING AGENCY MOBILE DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL VIBRACORE
4. HOLE NO. (As shown on drawing title and file number) VBL-28-87	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED 2 — UNDISTURBED —
5. NAME OF DRILLER FULLER	14. TOTAL NUMBER CORE BOXES —
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER N/A
	16. DATE HOLE — STARTED 7-16-87 — COMPLETED 7-16-87
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE -21.7
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 20.0' (EL. -41.7)	19. SIGNATURE OF INSPECTOR BRYANT & JONES D.G.H.

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-21.7			(ML) GRAY SANDY SILT W/SHELL FRAGS. (SOFT)		1	
-22.4	0.7		(SP) WHITE POORLY GRADED SAND W/TRACE SHELL FRAGS (FIRM)			
	12				2	LAB. TESTING # CLASS LL PL PI 2 (SP) — — —
-41.7	20		B.O.H.			

ENG FORM MAR 71 — PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT BAYOU LA BATRE; CHANNEL STUDY — HOLE NO. VBL-28-87

Hole No. VBL-29-8

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: MDO	SHEET 1 OF 1 SHEETS

1. PROJECT: BAYOU LA BATRE CHANNEL STUDY
2. LOCATION (Coordinates or Station): N 149,120 E 263,770
3. DRILLING AGENCY: MOBILE DISTRICT
4. HOLE NO. (As shown on drawing title and file number): VBL-29-87
5. NAME OF DRILLER: FULLER C.
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 16.9 (EL. -31.6)
10. SIZE AND TYPE OF BIT: VIBRACORE
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 5 | UNDISTURBED —
14. TOTAL NUMBER CORE BOXES: N/A
15. ELEVATION GROUND WATER: N/A
16. DATE HOLE: STARTED 7-13-87 | COMPLETED 7-13-87
17. ELEVATION TOP OF HOLE: -14.7
18. TOTAL CORE RECOVERY FOR BORING: N/A %
19. SIGNATURE OF INSPECTOR: Douglas B. Jones

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-14.7						
-17.1	2.4		(ML) BLK CLAYEY SILT MUCK W/ WOOD PARTICLES (VERY SOFT)		1	
	4		(SP) WHITE POORLY GRADED SAND W/ WOOD PARTICLES (FIRM)		2	
	6, 8		(SP) WHITE POORLY GRADED SAND (SILTY) W/ LAYERS OF CLAYEY SILT (ML) PURPLE BEIGE (FIRM)		3	LAB TESTING
	10, 12		(SP) YELLOW & ORANGE POORLY GRADED SAND W/ TR MICA (FIRM)		4	
-31.6	14, 16, 16.9		(SP) LT TAN & ORANGE POORLY GRADED SAND W/ LAYERS OF CLAYEY SILT RD & TAN (FIRM)		5	BOH

LAB TESTING

#	CLASS	LL	PL	PI
1	(CH)	—	—	—
2	—	—	—	— MA
3	(SP-SM)	—	—	—
4	(SP-SM)	—	—	—

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. | PROJECT: BAYOU LA BATRE CHANNEL STUDY | HOLE NO. VBL-29-8

Hole No. VBL-30-87

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: MDO	SHEET 1 OF 1 SHEETS

1. PROJECT: BAYOU LA BATRE CHANNEL STUDY
2. LOCATION (Coordinates or Station): N 146,784 E 261,489
3. DRILLING AGENCY: MOBILE DISTRICT
4. HOLE NO. (As shown on drawing title and file number): VBL-30-87
5. NAME OF DRILLER: FULLER C
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 12.7 (EL. -29.8)
10. SIZE AND TYPE OF BIT: VIBRACORE
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1-TUBE, 1-JAR; UNDISTURBED —
14. TOTAL NUMBER CORE BOXES: N/A
15. ELEVATION GROUND WATER: N/A
16. DATE HOLE: STARTED 7-14-87; COMPLETED 7-14-87
17. ELEVATION TOP OF HOLE: -17.1
18. TOTAL CORE RECOVERY FOR BORING: N/A %
19. SIGNATURE OF INSPECTOR: Douglas B. Jones

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-17.1			(ML) DK GRAY CLAYEY SILT	157	1	SAMPLE ONE (1) WAS CUT, SEALED & SENT TO DIV. LAB IN VIBRACORE TUBE
-20.1	3.0		(SP) YELLOW & ORANGE POORLY GRADED SAND (SILTY) MICA (FIRM)		2	LAB. TESTING # CLASS LL PL PI 1 (CH) 82 24 58 MA L.O.I. = 10.2, Sg = 2.53, γd = 26.7
-29.8	12.7					BOH

LAB. TESTING
Visual Classification and/or Remarks

SAM. #	DEPTH	Visual Classification and/or Remarks
1	0.0-2.7	Dark gray soupy disturbed organic clay (OH)w/trace of sand.
	2.7-3.0	Dark gray fat clay (CH), firmer, with trace of sand and organic material.

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: BAYOU LA BATRE CHANNEL STUDY

HOLE NO. VBL-30-87

Hole No. VBL-31-87

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: MDO	SHEET 1 OF 1 SHEETS

1. PROJECT: BAYOU LA BATRE CHANNEL STUDY
2. LOCATION (Coordinates or Station): N 146,010 E 268,730
3. DRILLING AGENCY: MOBILE DISTRICT
4. HOLE NO. (As shown on drawing title and file number): VBL-31-87
5. NAME OF DRILLER: FULLER C
6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 17.4 (EL. -33.1)
10. SIZE AND TYPE OF BIT: VIBRACORE
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 5 | UNDISTURBED —
14. TOTAL NUMBER CORE BOXES: N/A
15. ELEVATION GROUND WATER: N/A
16. DATE HOLE: STARTED 7-13-87 | COMPLETED 7-13-87
17. ELEVATION TOP OF HOLE: -15.7
18. TOTAL CORE RECOVERY FOR BORING: N/A %
19. SIGNATURE OF INSPECTOR: Douglas B. Jones

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-15.7			(ML) BLK CLAYEY SILT (VERY SOFT)	318	1	
-18.4	2.7					
			(SM) ORANGE & BRN SILTY SAND W/TR MICA (FIRM)		2	LAB. TESTING
-20.2	4.5					# CLASS LL PL PI #200 1 (CH) — — — 93 L.O.I. = 13.5 2 (SP-SM) — — — — 3 (SC) 31 16 15 24 4 (SP-SM) — — — — 5 (SP-SM) — — — —
			(ML) ORANGE & RD CLAYEY SILT WITH MICA (FIRM)	25	3	
-26.6	10.9					
			(SM) YELLOW SILTY SAND W/TR MICA (FIRM)		4	
-29.1	13.4					
			(SP) YELLOW POORLY GRADED SAND (SILTY) W/TR MICA (FIRM)		5	
-33.1	17.4					BOH

PROJECT: BAYOU LA BATRE CHANNEL STUDY | HOLE NO. VBL-31-87

Hole No. VBL-32-87

DRILLING LOG — DIVISION: SOUTH ATLANTIC	INSTALLATION: MDO — SHEET 1 OF 1 SHEETS
1. PROJECT: BAYOU LA BATRE CHANNEL STUDY	10. SIZE AND TYPE OF BIT: VIBRACORE
2. LOCATION (Coordinates or Station): N 144,879 E 259,530	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW
3. DRILLING AGENCY: MOBILE DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE
4. HOLE NO. (As shown on drawing title and file number): VBL-32-87	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED: 3-TUBES, 1-JAR — UNDISTURBED:
5. NAME OF DRILLER: FULLER C	14. TOTAL NUMBER CORE BOXES: N/A
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: N/A
7. THICKNESS OF OVERBURDEN	16. DATE HOLE — STARTED: 7-14-87 — COMPLETED: 7-14-87
8. DEPTH DRILLED INTO ROCK	17. ELEVATION TOP OF HOLE: -14.4
9. TOTAL DEPTH OF HOLE: 16.5 (EL -30.9)	18. TOTAL CORE RECOVERY FOR BORING: N/A %
	19. SIGNATURE OF INSPECTOR: Douglas B. Jones

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-14.4			(ML) DK GRAY CLAYEY SILT	144	1	LAB. TESTING # CLASS LL PL PI 1 (CH) 92 26 66 MA L.O.I. = 9.7, γ_d = 30.6 2 (SP) NP NP NP MA 3 (SP) - - - -
-18.2	3.8		(SP) GRAY POORLY GRADED SAND	21	2	SAMPLES 1, 2, & 3, WERE CUT, SEALED & SENT TO DIV. LAB IN VIBRACORE TUBE
-21.3	6.9		(SP) TAN POORLY GRADED SAND (SILTY) W/TR SHELL FRAGS		3	
-24.3	9.9				4	
			(SP) YELLO[illegible] E POORLY GR[illegible] SAND W/TR SHELL FRAGS ([illegible]IRM)			
-30.9	16.5					BOH

SAM. #	DEPTH	LAB. TESTING Visual Classification and/or Remarks
1	0.0-3.0	Black fat clay (CH), with some sand
	3.0-3.6	Light tan poorly graded sand (SP)
4		Light brown poorly graded sand (SP), with trace of gravel and shell fragments.

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: BAYOU LA BATRE CHANNEL STUDY — HOLE NO. VBL-32-87

Hole No. VBL-33-87

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION MDO	SHEET 1 OF 1 SHEETS
1. PROJECT BAYOU LA BATRE CHANNEL STUDY		10. SIZE AND TYPE OF BIT VIBRACORE	
2. LOCATION (Coordinates or Station) N 143,615 E 258,335		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW	
3. DRILLING AGENCY MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL VIBRACORE	
4. HOLE NO. (As shown on drawing title and file number) VBL-33-87		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 4; UNDISTURBED	
5. NAME OF DRILLER FULLER C		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE: STARTED 7-14-87; COMPLETED 7-14-87	
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE -14.0	
9. TOTAL DEPTH OF HOLE 13.3 (EL. -27.3)		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Douglas B Jones	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-14.0				312	1	
-17.8	3.8		(ML) BLK CLAYEY SILT (VERY SOFT)			LAB. TESTING #CLASS LL PL PI 1 (CH) — — — M.A. L.O.I = 11.8 2 — — — — MA 3 (SP) — — —
-20.2	6.2		(SM) DKGRAY SILTY SAND W/ WOOD FRAGS (FIRM)		2	
-24.7	10.7		(SM) ORANGE & TAN SILTY SAND (POORLY GRADED) W/TRACE GRAVEL (FIRM)		3	
-27.3	13.3		(SP) LT TAN POORLY GRADED SAND (SILTY) (FIRM)		4	BOH

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT BAYOU LA BATRE CHANNEL STUDY | HOLE NO. VBL-33-87

Hole No. VBL-34-87

DRILLING LOG	DIVISION: SOUTH ATLANTIC
INSTALLATION	MDO
SHEET 1 OF 1 SHEETS	
1. PROJECT	BAYOU LA BATRE CHANNEL STUDY
2. LOCATION (Coordinates or Station)	N 142,457 E 257,963
3. DRILLING AGENCY	MOBILE DISTRICT
4. HOLE NO. (As shown on drawing title and file number)	VBL-34-87
5. NAME OF DRILLER	FULLER C
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	13.8 (EL. -26.9)
10. SIZE AND TYPE OF BIT	VIBRACORE
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL	VIBRACORE
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: 4; UNDISTURBED: —
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER	N/A
16. DATE HOLE	STARTED: 7-14-87; COMPLETED: 7-14-87
17. ELEVATION TOP OF HOLE	-13.1
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. SIGNATURE OF INSPECTOR	Douglas B. Jones

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-13.1						LAB. TESTING # CLASS LL PL PI 1 (CH) 106 26 80 MA L.O.I. = 8.2, Sg = 2.59, γd = 26.5 2 (SM) NP NP NP MA Sg = 2.64, γd = 105.0 3 (SP) NP NP NP MA
-16.9	3.8		(ML) DK GRAY CLAYEY SILT	150	1	
-19.7	6.6		(SP) GRAY POORLY GRADED SAND (SILTY)	22	2	SAMPLES 2 & 3 WERE CUT SEALED & SENT TO DIV LAB IN VIBRACORE TUBES.
-22.7	9.6		(SP) TAN POORLY GRADED SAND		3	
-26.9	13.8		(SP) LT TAN POORLY GRADED SAND (SILTY) (FIRM)		4	BOH

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: BAYOU LA BATRE CHANNEL STUDY

HOLE NO. VBL-34-87

Hole No. VBL-35-87

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: MDO	SHEET 1 OF 1 SHEETS

1. PROJECT: BAYOU LA BATRE CHANNEL STUDY
2. LOCATION (Coordinates or Station): N 141,498 E 257,307
3. DRILLING AGENCY: MOBILE DISTRICT
4. HOLE NO. (As shown on drawing title and file number): VBL-35-87
5. NAME OF DRILLER: FULLER C
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 16.6 (EL. −29.1)
10. SIZE AND TYPE OF BIT: VIBRACORE
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL: VIBRACORE
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3, UNDISTURBED —
14. TOTAL NUMBER CORE BOXES: N/A
15. ELEVATION GROUND WATER: N/A
16. DATE HOLE: STARTED 7-14-87, COMPLETED 7-14-87
17. ELEVATION TOP OF HOLE: −12.5
18. TOTAL CORE RECOVERY FOR BORING: N/A %
19. SIGNATURE OF INSPECTOR: Douglas B. Jones

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
−12.5			(SM) SILTY SAND (MUCK) (LOOSE)		1	
−17.3	4.8		(MH) LT GRAY SANDY SILT W/ SP LAYERS & LENSES ORANGE & YELLOW (SOFT)	3?	2	* SAMPLE #2 TORVANE-0.07 T.S.F PENETROMETER-0.0 T.S.F
−19.7	7.2		(SP) YELLOW & ORANGE POORLY GRADED SAND (SILTY, (FIRM)		3	
−29.1	16.6					BOH

LAB TESTING

#	CLASS	LL	PL	PI	#200
1	—	—	—	—	MA
2	(SC)	—	—	—	44 —
3	(SP)	—	—	—	MA

Hole No. VBL-36-87

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: MDO	SHEET 1 OF 1 SHEETS

1. PROJECT	BAYOU LA BATRE CHANNEL STUDY
2. LOCATION (Coordinates or Station)	N 139,728 E 256,721
3. DRILLING AGENCY	MOBILE DISTRICT
4. HOLE NO. (As shown on drawing title and file number)	VBL-36-87
5. NAME OF DRILLER	FULLER C
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	18.2 (EL. -31.9)
10. SIZE AND TYPE OF BIT	VIBRACORE
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL	VIBRACORE
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: 4 / UNDISTURBED: —
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER	N/A
16. DATE HOLE	STARTED: 7-14-87 / COMPLETED: 7-14-87
17. ELEVATION TOP OF HOLE	-13.7
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-13.7			(ML) BLK CLAYEY SILT (VERY SOFT)	203	1	LAB. TESTING # CLASS LL PL PI #200 1 (CH) — — — 89 — L.O.I. = 9.5 2 (SP-SM) — — — — — 4 (SP) — — — — MA
-17.7	4.0		(SP) GRAYISH-GREY POORLY GRADED SAND (SILTY) W/ SOME RTEE WOOD (FIRM)		2	
-21.7	8.0		(CL) GRAY SANDY CLAY		3	*SAMPLE #3 TORVANE - 0.16 T.S.F PENETROMETER - 0.5 T.S.F
-22.9	9.2		(SP) YELLOW & BEIGE POORLY GRADED SAND (SILTY) (FIRM)	21	4	
-31.9	18.2					BOH

BAYOU La BATRE HARBOR AND CHANNEL IMPROVEMENTS, FEASIBILITY REPORT
LABORATORY TEST RESULTS FROM SAMPLES OBTAINED VIA 1987 VIBRACORE BORINGS

FILE NAME BATRE

BORING	SAMPLE EL. MLLW	LAB CLASS	FIELD CLASS	% WATER	LIQ. LIMIT	PLAS. LIMIT	PI	LOI	SPEC GRAV	DRY WT.	SAT. WT. (CALC'D)	TOR TSF	PEN TSF	C TSF	PHI	q TSF	SIEV ANAL	PLTR ANAL
VBL-1-87	-14.4/-14.8	CH	ML	219	147	32	115	11.9	2.62	-	78	-	-	-	-	-	MA/HY	NO
	-18.4/-18.8	-	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	MA	NO
	-22.4/-22.8	CH	CH	56	90	18	72	-	-	-	-	0.19	0.4	-	-	-	#200	NO
	-25.9/-26.0	SC	SC	24	33	16	17	-	-	-	-	0.21	0.85	-	-	-	MA	NO
VBL-2-87	-8.1/ -8.6	CH	ML	105	-	-	-	6.8	-	-	-	-	-	-	-	-	#200	NO
	-11.3/-11.8	SC	CL	43	-	-	-	-	-	-	-	-	-	-	-	-	#200	NO
	-12.6/-13.1	CH	MH	79	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
	-17.1/-17.6	CH	CH	47	50	20	30	-	-	-	-	0.018	0.25	-	-	-	#200	NO
	-21.1/-21.6	-	SM	-	-	-	-	-	-	-	-	-	-	-	-	-	MA	NO
	-23.9/-24.4	-	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
VBL-3-87	-12.6/-13.1	CH	ML	216	-	-	-	-	-	-	-	-	-	-	-	-	#200	NO
	-16.8/-17.2	CL	CL	52	40	15	25	-	-	-	-	0.08	-	-	-	-	#200	NO
	-22.6/-23.1	CH	CH	39	95	19	76	-	2.64	-	114	0.49	0.75	-	-	-	MA/HY	NO
VBL-4-87	-12.7/-13.2	-	ML	262	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
	-18.7/-19.2	CH	CH	-	-	-	-	-	-	-	-	0.31	1.00	-	-	-	-	NO
	-20.9/-21.4	-	SM	-	-	-	-	-	-	-	-	-	-	-	-	-	MA	NO
	-23.3/-23.8	CL	ML	49	40	23	17	-	-	-	-	0.18	0.40	-	-	-	#200	NO
	-27.5/-28.0	-	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
VBL-5-87	-13.1/-13.6	CH	ML	-	68	16	52	-	-	-	-	0.01	0.00	-	-	-	#200	NO
	-17.1/-17.6	SM	SM	32	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
	-19.1/-19.6	SP	MH	21	-	-	-	-	-	-	-	0.044	0.00	-	-	-	#200	NO
	-26.6/-27.1	-	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	MA	NO
VBL-6-87	-15.2/-15.7	CH	ML	104	71	17	54	-	2.65	-	91	0.024	0.00	-	-	-	MA/HY	NO
	-20.2/-20.7	SC	CL	31	-	-	-	-	-	-	-	0.094	0.25	-	-	-	#200	NO
	-25.2/-25.7	CH	CH	29	-	-	-	-	-	-	-	0.40	0.75	-	-	-	#200	NO
VBL-7-87	-13.4/-13.9	CH	ML	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
	-15.4/-15.9	CH	MH	77	67	18	49	-	-	-	-	0.002	0.10	-	-	-	#200	NO
	-18.4/-18.9	SC	ML	34	-	-	-	-	-	-	-	0.010	0.15	-	-	-	#200	NO
	-25.8/-26.3	CH	ML	-	-	-	-	-	-	-	-	0.036	0.10	-	-	-	-	NO
	-28.0/-28.4	-	SM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
VBL-8-87	-16.2/-16.7	CH	ML	74	59	16	43	-	-	-	-	0.028	0.00	-	-	-	MA/HY	NO
	-21.2/-21.7	CH	CL	-	-	-	-	-	-	-	-	0.45	0.25	-	-	-	-	NO
	-25.7/26.2	-	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	MA	NO
VBL-9-87	-12.9/-13.4	CH	ML	187	-	-	-	11.0	-	-	-	-	-	-	-	-	#200	NO
	-16.1/-16.6	CH	ML	87	-	-	-	-	-	-	-	-	-	-	-	-	#200	NO
	-20.7/-21.2	SC	SC	30	-	-	-	-	-	-	-	-	-	-	-	-	MA	NO
	-25.2/-25.7	CH	CH	52	-	-	-	-	-	-	-	0.40	0.75	-	-	-	#200	NO
VBL-10-87	-17.7/-18.2	CH	ML	20	-	-	-	-	-	-	-	0.014	0.0	-	-	-	#200	NO
	-23.0/-23.5	CH	CH	85	76	20	56	-	-	-	-	0.46	1.8	-	-	-	#200	NO
VBL-11-87	-17.9/-18.4	CH	ML	122	91	23	68	-	-	-	-	0.012	0.0	-	-	-	#200	NO
	-22.4/-22.9	CH	CH	25	-	-	-	-	-	-	-	0.70	1.25	-	-	-	#200	NO
VBL-12-87	-19.7/-20.2	CH	ML	96	-	-	-	-	-	-	-	-	-	-	-	-	#200	NO
	-26.7/-27.2	CH	CH	29	-	-	-	-	-	-	-	0.61	1.25	-	-	-	#200	NO
VBL-13-87	-19.4/-19.9	CH	ML	97	-	-	-	-	-	-	-	0.02	0.0	-	-	-	#200	NO
	-23.2/-23.7	CH	CL	-	-	-	-	-	-	-	-	0.31	0.45	-	-	-	-	NO
	-27.6/-28.1	CH	CH	28	74	17	57	-	-	-	-	0.70	1.25	-	-	-	#200	NO
VBL-14-87	-19.0/-19.5	CH	ML	87	77	20	57	-	-	-	-	0.012	0.0	-	-	-	#200	NO
	-25.5/-26.0	CH	CH	35	-	-	-	-	-	-	-	0.7	1.25	-	-	-	-	NO

BAYOU La BATRE HARBOR AND CHANNEL IMPROVEMENTS, FEASIBILITY REPORT
LABORATORY TEST RESULTS FROM SAMPLES OBTAINED VIA 1987 VIBRACORE BORINGS

FILE NAME BATRE

BORING	SAMPLE EL. MLLW	LAB CLASS	FIELD CLASS	% WATER	LIQ. LIMIT	PLAS. LIMIT	PI	LOI	SPEC GRAV	DRY WT.	SAT. WT. (CALC'D)	TOR TSF	PEN TSF	C TSF	PHI	q TSF	SIEV ANAL	PETR ANAL
VBL-15-87	-14.0/-17.0	CH	ML	164	-	-	-	-	2.65	44.7	82	-	-	-	-	-	-	NO
	-17.0/-20.0	CH	ML	98	79	20	59	11.6	2.70	40.3	92	-	-	-	-	-	MA/HY	NO
	-20.0/-23.0	CH	ML	81	-	-	-	-	2.69	-	98	-	-	-	-	-	-	NO
u.d. **	-14.0/-17.0	CH	ML	102	-	-	-	-	2.65	44.7	91	-	-	-	-	0.29	-	NO
u.d. **	-17.0/-20.0	CH	ML	91	79	20	59	11.6	2.70	48.0	94	-	-	-	-	0.04	MA/HY	NO
u.d. **	-20.0/-23.0	CH	ML	75	-	-	-	-	2.69	55.0	98	-	-	-	-	0.11	-	NO
	-25.5/-26.0	CH	CH	27	-	-	-	-	-	-	-	0.68	1.2	-	-	-	#200	NO
VBL-16-87	-21.1/-21.6	CH	ML	73	65	16	49	-	-	-	-	0.066	0.35	-	-	-	#200	NO
VBL-17-87	-19.9/-20.4	CH	ML	98	-	-	-	-	-	-	-	0.024	0.0	-	-	-	#200	NO
	-22.9/-23.4	CH	CH	41	-	-	-	-	-	-	-	0.33	0.5	-	-	-	#200	NO
VBL-18-87	-18.6/-19.1	CH	ML	95	-	-	-	-	-	-	-	0.012	0.0	-	-	-	#200	NO
	-25.1/-25.6	CH	CL	21	-	-	-	-	-	-	-	0.35	0.75	-	-	-	#200	NO
	-27.3/-27.8	CH	CH	33	-	-	-	-	-	-	-	0.62	1.25	-	-	-	#200	NO
VBL-19-87	-14.5/-15.0	CH	ML	170	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
	-21.8/-22.3	CH	ML	79	-	-	-	-	-	-	-	0.042	0.0	-	-	-	#200	NO
	-23.5/-24.0	CL	CH	29	37	14	23	-	2.67	-	122	0.14	0.25	-	-	-	#200	NO
	-25.5/-26.0	CH	CH	30	-	-	-	-	-	-	-	0.51	1.30	-	-	-	-	NO
	-28.0/-28.5	CH	ML	24	-	-	-	-	-	-	-	0.29	0.00	-	-	-	-	NO
VBL-20-87	-14.7/-15.2	CH	ML	92	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
	-16.7/-17.2	CH	ML	-	-	-	-	-	-	-	-	0.06	0.20	-	-	-	-	NO
	-21.7/-22.2	CH	CH	-	-	-	-	-	-	-	-	0.55	1.70	-	-	-	-	NO
	-24.2/-24.7	SM	SM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
VBL-21-87	-16.7/-17.2	CH	ML	87	-	-	-	-	-	-	-	0.018	0.0	-	-	-	-	NO
	-21.7/-22.2	CH	ML	114	-	-	-	-	-	-	-	0.05	0.0	-	-	-	#200	NO
	-26.7/-27.2	CH	CH	-	-	-	-	-	-	-	-	0.1	0.25	-	-	-	-	NO
VBL-22-87	-15.8/-18.8	CH	ML	99	67	15	52	-	2.65	58.6	92	-	-	-	-	-	MA/HY	NO
	-18.8/-21.8	SC	ML	-	-	-	-	-	-	-	-	-	-	-	-	-	#200	NO
	-24.8/-29.2	SC&CH	ML	-	-	-	-	-	-	-	-	-	-	-	-	-	#200	NO
	-24.8/-29.2	CH	SC	22	-	-	-	-	-	-	-	0.45	1.0	-	-	-	#200	NO
VBL-23-87	-16.3/-16.8	SP	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	MA	NO
	-20.3/-20.8	CL	CH	91	86	26	60	-	-	-	-	0.052	0.0	-	-	-	#200	NO
	-24.3/-24.8	CH	CH	-	-	-	-	-	-	-	-	0.68	1.0	-	-	-	-	NO
VBL-24-87	-15.9/-16.4	-	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	MA	NO
	-22.4/-22.9	SM	SC	34	-	-	-	-	-	-	-	0.05	0.0	-	-	-	#200	NO
	-26.4/-26.9	CH	CH	-	-	-	-	-	-	-	-	0.18	0.25	-	-	-	-	NO
VBL-25-87	-12.9/-13.4	SP	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	MA	NO
	-18.1/-18.6	CH	CL	73	77	20	57	-	-	-	-	0.064	0.0	-	-	-	#200	NO
VBL-26-87	-14.9/-15.4	SP	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	MA	NO
VBL-27-87	-7.2/-10.2	SP	SP	-	NP	NP	NP	-	-	-	-	-	-	-	-	-	MA	YES
	-10.2/-13.2	SP	SP	18	NP	NP	NP	-	2.62	105.4	132		-	-	-	-	MA/HY	YES
	-13.2/-16.2	SP	SP	17	NP	NP	NP	-	-	106.2	134	-	-	-	-	-	MA	NO
	-16.2/-19.2	SP	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
	-19.7/-20.2	SP-SM	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
	-22.4/-22.9	CH	CH	60	85	22	63	-	-	-	-	0.10	0.0	-	-	-	#200	NO
VBL-28-87	-21.7/-22.4	-	ML	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
	-33.2/-33.7	SP	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO

BAYOU La BATRE HARBOR AND CHANNEL IMPROVEMENTS, FEASIBILITY REPORT
LABORATORY TEST RESULTS FROM SAMPLES OBTAINED VIA 1987 VIBRACORE BORINGS

FILE NAME BATRE

BORING	SAMPLE EL. MLLW	LAB CLASS	FIELD CLASS	% WATER	LIQ. LIMIT	PLAS. LIMIT	PI	LOI	SPEC GRAV	DRY WT.	SAT. WT. (CALC'D)	TOR TSF	PEN TSF	C TSF	PHI	q TSF	SIEV ANAL	PETR ANAL
The following borings (29-36) are from within Bayou La Batre Harbor:																		
VBL-29-87	-15.9/-16.4	CH	ML	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
	-18.2/-18.7	-	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	MA	NO
	-21.7/-22.2	SP-SM	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
	-25.4/-25.9	SP-SM	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
	-29.4/-29.9	-	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
VBL-30-87	-17.1/-20.1	CH	ML	157	82	24	58	10.2	2.53	26.7	82	-	-	-	-	-	MA/HY	NO
	-20.1/-29.8	-	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
VBL-31-87	-15.7/-16.2	CH	ML	318	-	-	-	13.5	-	-	-	-	-	-	-	-	#200	NO
	-18.7/-19.2	SP-SM	SM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
	-25.9/-26.4	SC	ML	25	31	16	15	-	-	-	-	-	-	-	-	-	#200	NO
	-26.9/-27.4	SP-SM	SM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
	-32.6/-33.1	SP-SM	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
VBL-32-87	-14.4/-18.2	CH	ML	144	92	26	66	9.7	-	30.6	-	-	-	-	-	-	MA/HY	NO
	-18.2/-21.3	SP	SP	21	NP	NP	NP	-	2.64	100.8	130	-	-	-	-	-	MA/HY	YES
	-18.2/-21.3	SP	SP	19.45	NP	NP	NP	-	2.64	101.3	131	-	-	0	29	-	MA/HY	YES
u. d. **	-21.3/-24.3	SP	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
	-25.3/-25.8	-	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
VBL-33-87	-14.0/-14.5	CH	ML	312	-	-	-	11.8	-	-	-	-	-	-	-	-	MA/HY	NO
	-19.6/-20.1	-	SM	-	-	-	-	-	-	-	-	-	-	-	-	-	MA	NO
	-24.2/-24.7	SP	SM	-	-	-	-	-	-	-	-	-	-	-	-	-	MA	NO
	-26.0/-26.5	-	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
VBL-34-87	-13.1/-16.9	CH	ML	150	106	26	80	8.2	2.59	26.3	84	-	-	-	-	-	MA/HY	NO
	-16.9/-19.7	SM	SP	22	NP	NP	NP	-	2.64	105.0	128	-	-	-	-	-	MA/HY	YES
u. d. **	-16.9/-19.7	SM	SP	20.7	NP	NP	NP	-	2.64	106.0	130	-	-	0	38	-	MA/HY	YES
	-19.7/-22.7	-	SP	-	NP	NP	NP	-	-	-	-	-	-	-	-	-	MA	NO
	-24.8/-25.3	-	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
VBL-35-87	-13.5/-14.0	-	SM	-	-	-	-	-	-	-	-	-	-	-	-	-	MA	NO
	-17.5/-17.8	SC	MH	39	-	-	-	-	-	-	-	0.07	0.0	-	-	-	#200	NO
	-24.5/-25.0	SP	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	MA	YES
VBL-36-87	-16.2/-16.7	CH	ML	203	-	-	-	9.5	-	-	-	-	-	-	-	-	#200	NO
	-18.7/-19.2	SP-SM	SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NO
	-22.0/-22.5	-	CL	-	-	-	-	-	-	-	-	0.16	0.5	-	-	-	MA/HY	NO
	-26.2/-26.7	SP	SP	21	-	-	-	-	-	-	-	-	-	-	-	-	MA	NO

CESADEN-FL
SAD Lab No. 57/3390A

17 November 1987

PETROGRAPHIC REPORT
SAND SAMPLE FROM BORING VBL-27-89 (d. 3.6 ft.)
BAYOU LA BATRE HARBOR
MOBILE DISTRICT

1. The natural sand sample from Boring VBL-27-87, depth 3.6 ft., Bayou La Batre Channel, consists almost entirely of siliceous constitutents with trace amounts of shell fragments. The sand is whitish gray with visible shell and shell fragments in the No. 20 and 40 sieve size fractions.

2. A breakdown of the constituents comprising this sand sample, including the sand gradation, appear in TABLE 1 (SAD FORM 3195). A brief description of the constituents listed in TABLE 1 appears below.

SAND DESCRIPTION

3. Clear, glassy, subangular to angular quartz particles comprise 99% of the natural sand at this depth. Many are translucent and contain inclusions. Typically, the quartz particles are more rounded (subround to subangular) in the coarser sieve sizes (plus No. 60 sieve size fraction) but become more angular in the No. 60 and below sizes. The quartz constituents are fresh, sound, and durable.

4. White, pink, and gray shell and [illegible] fragments make up less than 1% of the total sample, hence they are reported as "trace" amounts in TABLE 1. Intact shells, although small, occur only in the coarser sand sizes (No. 40 and larger

sieve sizes). Fragmental shelly debris is found in minute amounts even in the No. 200 sieve size.

5. The miscellaneous fraction, which makes up about 1% of the sand, consist of a suite of heavy minerals.* Most of these are metamorphic in origin. Typical examples include: ilmenite, rutile, sphene, tourmaline, and pyrite. These type particles are only significant in the minus No. 60 sieve size fractions. Most of these particles are fresh and sound.

ATTACHED
TABLE 1 (SAD Form 3195)

RAY WILLINGHAM
Geologist

*Minerals with specific gravities generally greater than about 2.65.

U. S. ARMY ENGINEER DIVISION LABORATORY, SOUTH ATLANTIC
CORPS OF ENGINEERS
MARIETTA, GEORGIA

TABLE I

AGGREGATE COMPOSITION AND CONDITION REPORT

DISTRICT: Mobile

PROJECT: Bayou La Batre Channel & Harbor Deepening

CONTRACT NO.: N/A

SOURCE: VBL-27-87 (d. 3 - 6 ft.)

LAB. NO.: 57/3390A

DATE REPORTED: 12 November 1987

DATE RECEIVED: 31 July 1987

REQ. NO.: 40-87-F&M

WORK ORDER NO.: 5323

DESCRIPTION: Natural Sand

	Weighted Average (Percent)	#10	#20	#40	#60	#100	#200	Pan		
		SIEVE SIZE (% Retained)								
Sample Gradation		Tr	Tr*	23	65	10	1	1		
Quartz	99	--	61	99	99	98	95	--		
Shell Fragments	Tr	--	39	1	Tr	Tr	Tr	--		
Miscellaneous Other (Heavy Mineral Suite)	1	--	--	Tr	1	2	5	--		

CONDITION:

Percent Flat and Elongated N/A

REMARKS:

Petrographic analysis based on examination of 300 particles whenever possible.

*Not enough particles to be included in calculation. Size fraction consisted of only a few shell fragments and quartz particles.

Sand was wash sieved prior to petrographic examination.

REPORTED BY: ☐ PHONE ☐ WIRE

DATE ____________

TESTED BY: RW

CHECKED BY: WLT

SAMPLED BY: Unknown

SAD FORM 3186
1 Dec 81

CESADEN-FL 17 November 1987
SAD Lab No. 57/3405A

PETROGRAPHIC REPORT
SAND SAMPLE FROM BORING VBL-32-87 (d.4.8 ft.)
BAYOU LA BATRE HARBOR
MOBILE DISTRICT

1. The natural sand from Boring VBL-32-87, depth 4.8 ft., Bayou La Batre Harbor is a white to whitish gray sand consisting predominantly of quartz particles with some quartzite. Traces (less than 1%) of organic debris, heavy minerals, and muscovite mica are also present. The weighted averages and relative amount in each sieve size fraction along with the sample gradation appears in TABLE 1 (SAD FORM 3195).

DETAILED PETROGRAPHY

2. Quartzite particles make up 2% of the total sand sample. These type particles occur primarily in the plus No. 40 sieve size fractions as shown in TABLE 1. Most are either white or translucent with subangular shapes. Traces of fine grained white quartzite are found in the minus No. 40 sieve sizes. In general, the particles comprising this group appear sound.

3. Clear, glassy to translucent quartz grains comprise 98% of the sand. The quantity of these increase with decreasing grain size as shown in TABLE 1. Subangular particles are more prevalent in the coarser sieve sizes (plus No. 20 sieve size). Angular shapes are dominant in the smaller fractions. White, yellow and pinkish grains occur in trace quantities. Many of the quartz particles appear to be derived from quartzite, particulary those in the very fine fractions.

CESAD-EN-FL 17 November 1987

4. The remaining particles in the sand collectively make up less than 1% of the total sample. This group includes mica flakes, feldspar, organic debris and the and a suite of heavy minerals* (e.g., hematite, pyrite, epidote, rutile, tourmaline and others) which are significant only in the No's. 100 and 200 sieve size fractions. The mica is the more weather resistant muscovite variety. The organic debris is mostly plant and woody matter.

Ray Willingham

Attached
TABLE 1 (SAD Form 3195)

RAY WILLINGHAM
Geologist

*Minerals with specific gravities greater than about 2.65.

U. S. ARMY ENGINEER DIVISION LABORATORY, SOUTH ATLANTIC
CORPS OF ENGINEERS
MARIETTA, GEORGIA

TABLE I

AGGREGATE COMPOSITION AND CONDITION REPORT

DISTRICT	Mobile
PROJECT	Bayou La Batre
CONTRACT NO.	N/A
SOURCE	VBL-32-87 (d. 4.8 ft.)
LAB. NO.	57/3405A
DATE REPORTED	12 November 1987
DATE RECEIVED	31 July 1987
REQ. NO.	40-87-F&M
WORK ORDER NO.	5323

DESCRIPTION: Natural Sand	Weighted Average (Percent)	SIEVE SIZE (% Retained) #10	#20	#40	#60	#100	#200	Pan		
Sample Gradation		1*	2	16	56	20	4	1*		
Quartzite	2	75	25	5	1	Tr	Tr	--		
Quartz	98	25	73	95	99	99	97	--		
Miscellaneous Suite of Heavy Minerals	Tr	--	--	--	Tr	1	3	--		
Other (Organic debris)	Tr	--	2	--	--	--	Tr	--		
Mica (Muscovite)	Tr	--	--	--	--	Tr	Tr	--		
CONDITION: Percent Flat and Elongated										

REMARKS:

Petrographic analysis based on examination of 300 particles whenever possible. Sample was wash sieved prior to petrographic examination.

*These sieve sizes not included in weighted average calculation.

REPORTED BY: ☐ PHONE ☐ WIRE	TESTED BY RW
	CHECKED BY WLT
DATE	SAMPLED BY Unknown

SAD FORM 3195
1 Dec 81

CESAD-EN-FL 17 November 1987
SAD Lab No. 57/3411A

PETROGRAPHIC REPORT
SAND SAMPLE FROM BORING VBL-34-87 (d.6.2 ft.)
BAYOU LA BATRE HARBOR
MOBILE DISTRICT

1. The constituents comprising the natural sand sample from VBL-34-87 (d.6.2 ft.) appear yellowish tan in color due primarily to iron stain. This sand consists almost entirely of quartz particles (98%), with a small amount of quartzite and heavy minerals. Traces of soft, crumbly particles and mica were also found. The constituents comprising the sample are listed in TABLE 1 (SAD FORM 3195). The percent of each constituent group in the various sieve size fractions along with the weighted average (total sample) and sample gradation also appear in the table.

FINDINGS

2. Almost the entire sand sample is quartz and quartzite particles. The quartzite particles are only 1 percent of the sample. These are typically white, subangular in shape with some surface stain.

3. Quartz particles, which are 98% of the natural sand, occur in all sieve size fractions. These are typically clear or translucent; about 1/3 of the quartz group is translucent . White, pale pink, and yellowish orange grains are also common. Iron oxide surface stain is present especially on particles with irregular surfaces. Angular shaped particles are typical of this group of particles.

4. A small amount of miscellaneous heavy minerals* (less than 1%) appear in the No's. 100 and 200 sieve size fractions. These are round to angular particles that are typically resistant to weathering. Examples from this group are: tourmaline, rutile, ilmenite, pyrite and other opaque minerals.

5. Soft weathered particles (probably feldspar) and a few flakes of muscovite mica occur in trace quantities.

Attached
TABLE 1 (SAD Form 3195)

Ray Willingham

RAY WILLINGHAM
Geologist

*Minerals with specific gravities greater than about 2.65

U. S. ARMY ENGINEER DIVISION LABORATORY, SOUTH ATLANTIC
CORPS OF ENGINEERS
MARIETTA, GEORGIA

AGGREGATE COMPOSITION AND CONDITION REPORT

DISTRICT: Mobile
PROJECT: Bayou La Batre
CONTRACT NO.: --

SOURCE: VBL-34-87 (d. 6.2 ft.)
LAB. NO.: 57/3411A
DATE REPORTED: 12 November 1987
DATE RECEIVED: 31 July 1987
REQ. NO.: 40-87-F&M
WORK ORDER NO.: 5323

DESCRIPTION: Natural Sand	Weighted Average (Percent)	SIEVE SIZE (% Retained)								
		#10	#20	#40	#60	#100	#200	Pan		
Sample Gradation		--	Tr*	7	42	30	13	8		
Quartzite	1	--	6	2	1	Tr	--	--		
Quartz	98	--	93	98	99	99	98	--		
Miscellaneous Suite of Heavy Minerals	1	--	--	--	Tr	1	2	--		
Other (Soft Weathered Particles)	Tr	--	1	--	--	--	--	--		
Mica	Tr	--	--	Tr	Tr	--	--	--		
CONDITION: Percent Flat and Elongated										

REMARKS:

Petrographic analysis is based on examination of 300 particles whenever possible. Sand was washed prior to petrographic analysis.

*Less than 1 percent by weight - not considered in weighted average calculations.

REPORTED BY: ☐ PHONE ☐ WIRE
DATE ____________

TESTED BY: WRW
CHECKED BY: WLT
SAMPLED BY: Unknown

SAD FORM 3186
1 Dec 81

CESAD-EN-FL 17 November 1987
SAD Lab No. 57/3414

PETROGRAPHIC REPORT
SAND SAMPLE FROM BORING VBL-35-87 (Jar No.3)
BAYOU LA BATRE HARBOR, MOBILE DISTRICT

1. Jar sample No. 3, Boring VBL-35-87, consists almost entirely of siliceous constituents (quartz with a small quantity of quartzite particles). Other constituents occuring in trace amounts (less than 1%) include a few soft, weathered particles, white mica, and a small suite of miscellaneous heavy minerals*. The overall color of the natural sand is whitish gray. It is free of organic debris and shell fragments.

2. A breakdown of the constituents comprising the sand, including their weighted averages, and the sand gradation appear in TABLE 1 (SAD FORM 3195). A brief description of the constituent groups comprising the sand sample appears below.

SAMPLE DESCRIPTION

3. Fresh, sound, clean quartz particles are 97% of the sample. Approximately 60% of these are clear, glassy, particles with angular shapes. The rest are translucent, white, tan, yellowish orange or pale pink. Some well rounded, slightly frosted particles are present. Most of the minus No. 60 sieve size fractions are clear or translucent particles with highly angular shapes. The quartzite particles are typically white with a fine sugary texture and subangular shape.

*Minerals with a specific gravity greater than 2.65.

CESAD-EN-FL 17 November 1987

4. Ilmenite, hematite, tourmaline, rutile, monazite, et.al. comprise the heavy mineral suite. These minerals are about 3% of the No. 200 sieve size fraction, but make up less than 1% of the total sample. Therefore they are reported as a "trace" in TABLE 1. A few extremely weathered, soft feldspar particles were found in the No. 20 size fraction. A few flakes of muscovite mica are in the sand also.

Ray Willingham

RAY WILLINGHAM
Geologist

Attached
TABLE 1 (SAD Form 3195)

*Minerals with a specific gravity greater than 2.65.

U. S. ARMY ENGINEER DIVISION LABORATORY, SOUTH ATLANTIC
CORPS OF ENGINEERS
MARIETTA, GEORGIA

TABLE I

AGGREGATE COMPOSITION AND CONDITION REPORT

DISTRICT: Mobile	PROJECT: Bayou La Batre	CONTRACT NO.: N/A	
SOURCE: VBL-35-87 (Jar #3)	LAB. NO.: 57/3414	DATE REPORTED: 12 November 1987	
DATE RECEIVED: 31 July 1987	REQ. NO.: 40-87-F&M	WORK ORDER NO.: 5323	

DESCRIPTION: Natural Sand	Weighted Average (Percent)	SIEVE SIZE (% Retained) #10	#20	#40	#60	#100	#200	Pan		
Sample Gradation		--	Tr*	9	62	23	3	3		
Quartz	97	--	83	96	97	99	97	--		
Quartzite	3	--	15	4	3	1	--	--		
Miscellaneous Suite of Heavy Minerals	Tr	--	--	--	Tr	Tr	3	--		
Soft Weathered Particles	Tr	--	2	Tr	Tr	--	--	--		
Mica	Tr	--	--	Tr	Tr	Tr	--	--		
CONDITION: Percent Flat and Elongated										

REMARKS:

Petrographic analysis is based on examination of 300 particles whenever possible. Sand was washed prior to petrographic analysis.

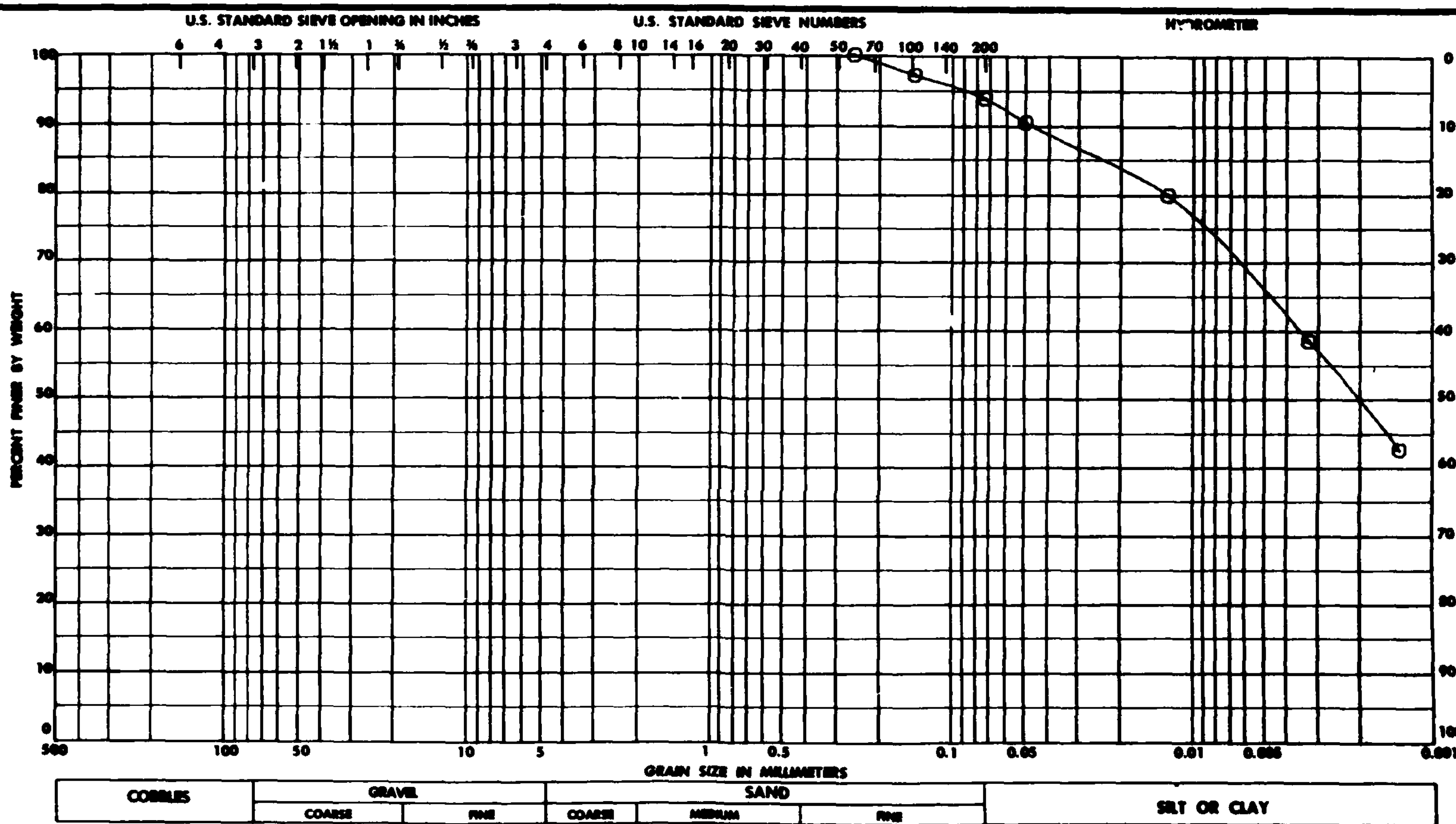
*Less than 1% by weight - not considered in weighted average calculation.

REPORTED BY: ☐ PHONE ☐ WIRE	TESTED BY: WRW	CHECKED BY: WLT
DATE	SAMPLED BY: Unknown	

SAD FORM 3186
1 Dec 81

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323
Req. No. 40-87-F&M



Sample No.	Depth	Classification	Nat w %	LL	PL	PI
1		FAT CLAY (CH)	218.6	147	32	115
		DK. GRAY. W/A TRACE OF SAND				
		SPECIFIC. GRAVITY=2.62				
		L.O.I.=11.9				

Project: BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING
Area: LAB NO. 57/3314
Boring No. VBL-1-87 .SAMPLE 1
Date: 09/23/87

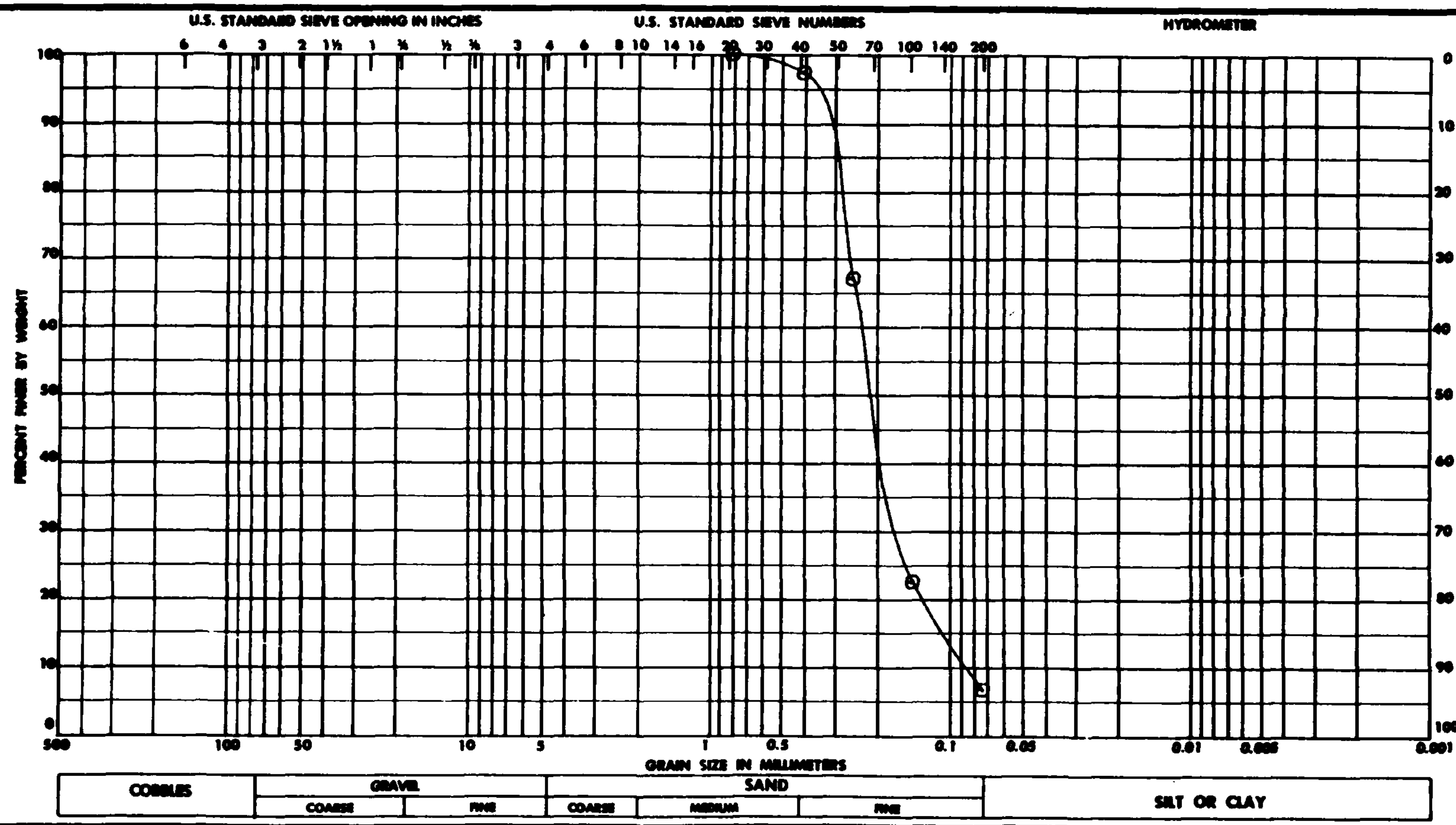
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Depth	VISUAL Classification	Nat w %	LL	PL	PI
2		CLASS. NOT REQUESTED	--	--	--	--
		.				

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3315

Boring No. VBL-1-87 .SAMPLE 2

Date 09/23/87

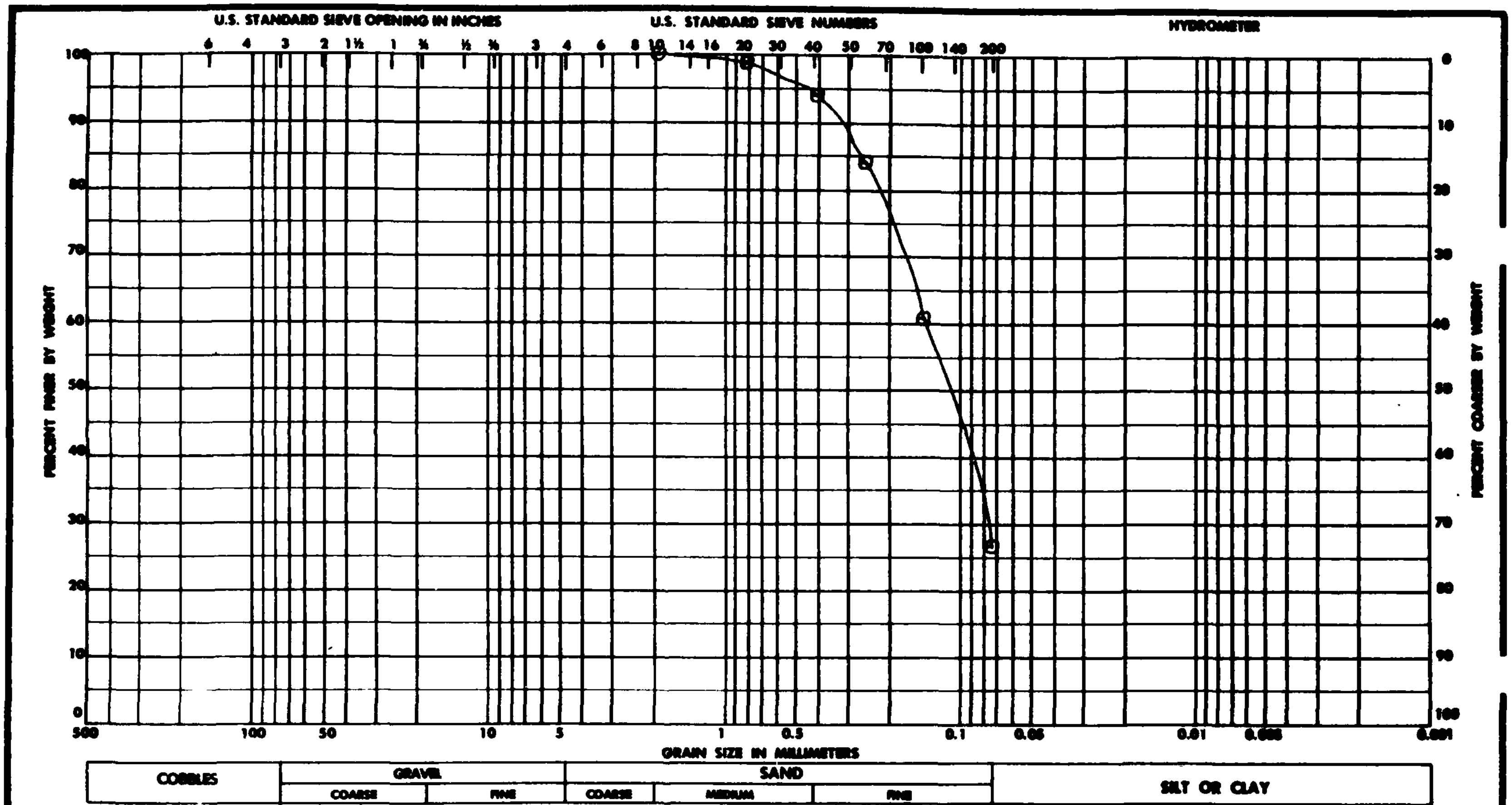
GRADATION CURVES

ENG FORM 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
4		CLAYEY SAND (SC)	24.0	33	16	17
		DK. GRAY. W/. TRACE OF MICA				

Project: BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area: LAB NO. 57/3317

Boring No. VBL-1-87 . SAMPLE 4

Date: 09/23/87

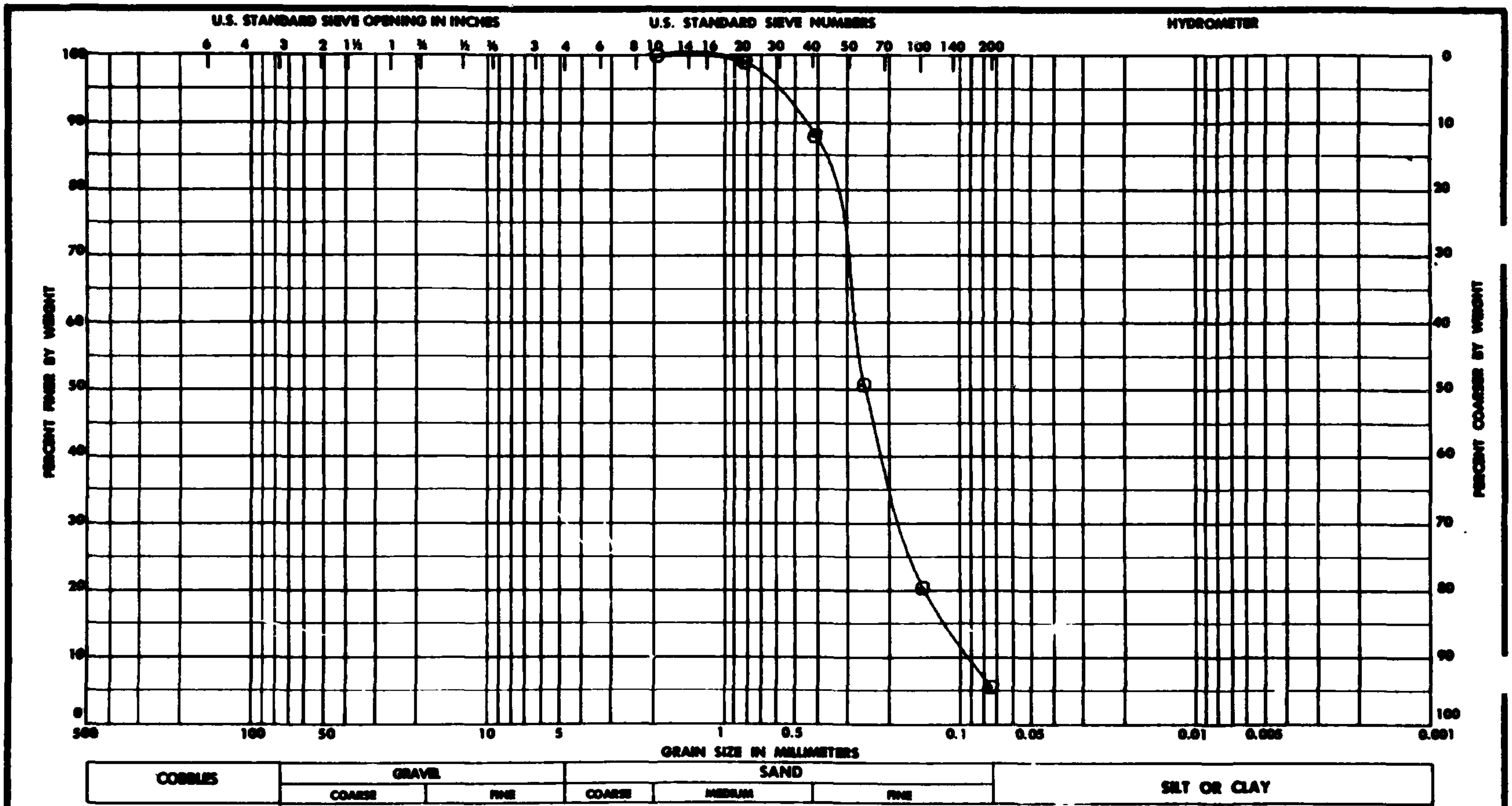
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Depth	VISUAL Classification	Nat w %	LL	PL	PI
5		CLASS. NOT REQUESTED	--	--	--	--

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3322

Boring No. VBL-2-87 . SAMPLE 5

Date 09/23/87

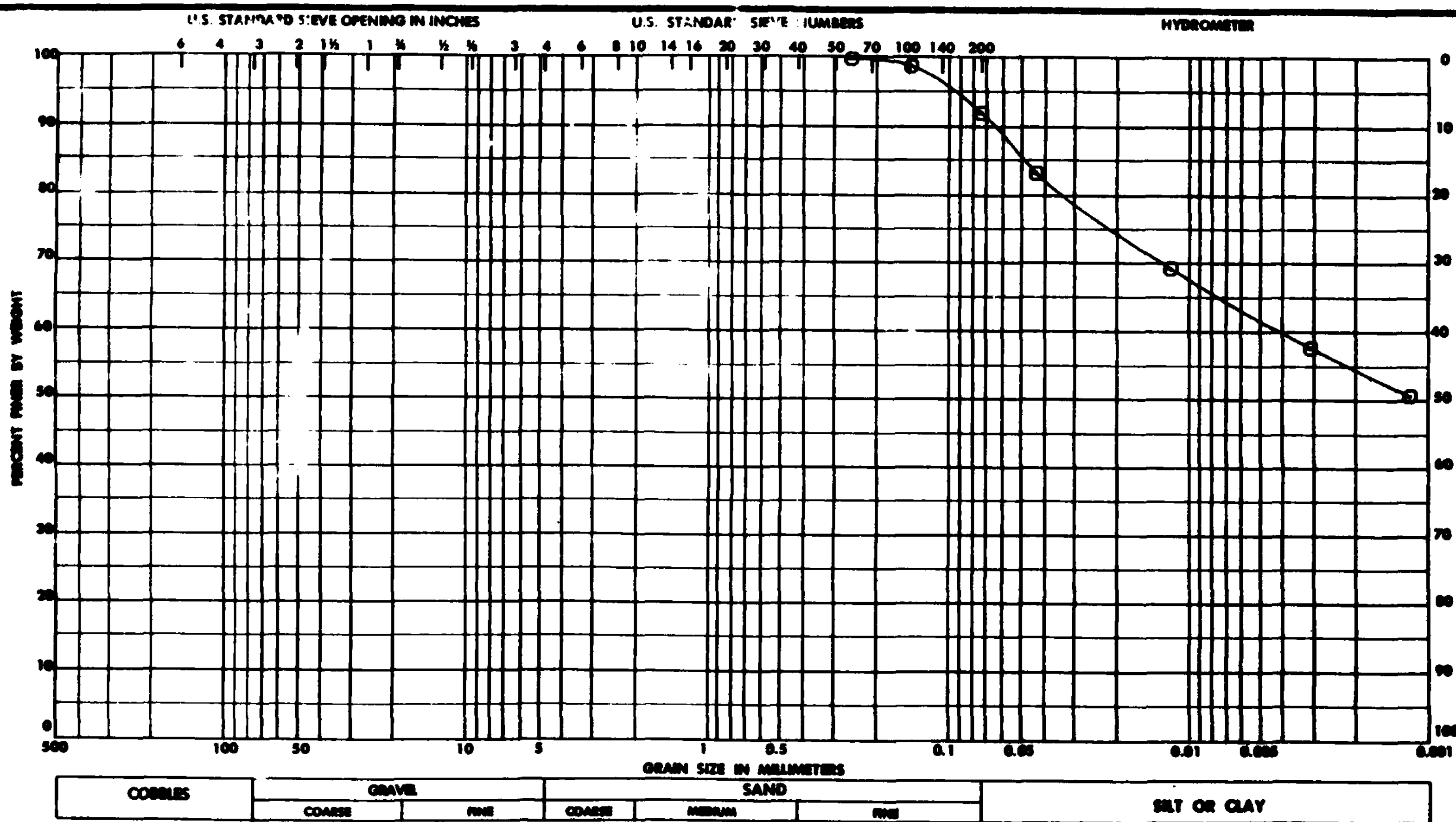
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
3		FAT CLAY (CH)	38.9	95	19	76
		LT. & DK. GRAY. W/A TRACE OF				
		SAND				
		SPECIFIC: GRAVITY=2.64				

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3325

Boring No. VBL-3-87 , SAMPLE 3

Date 09/23/87

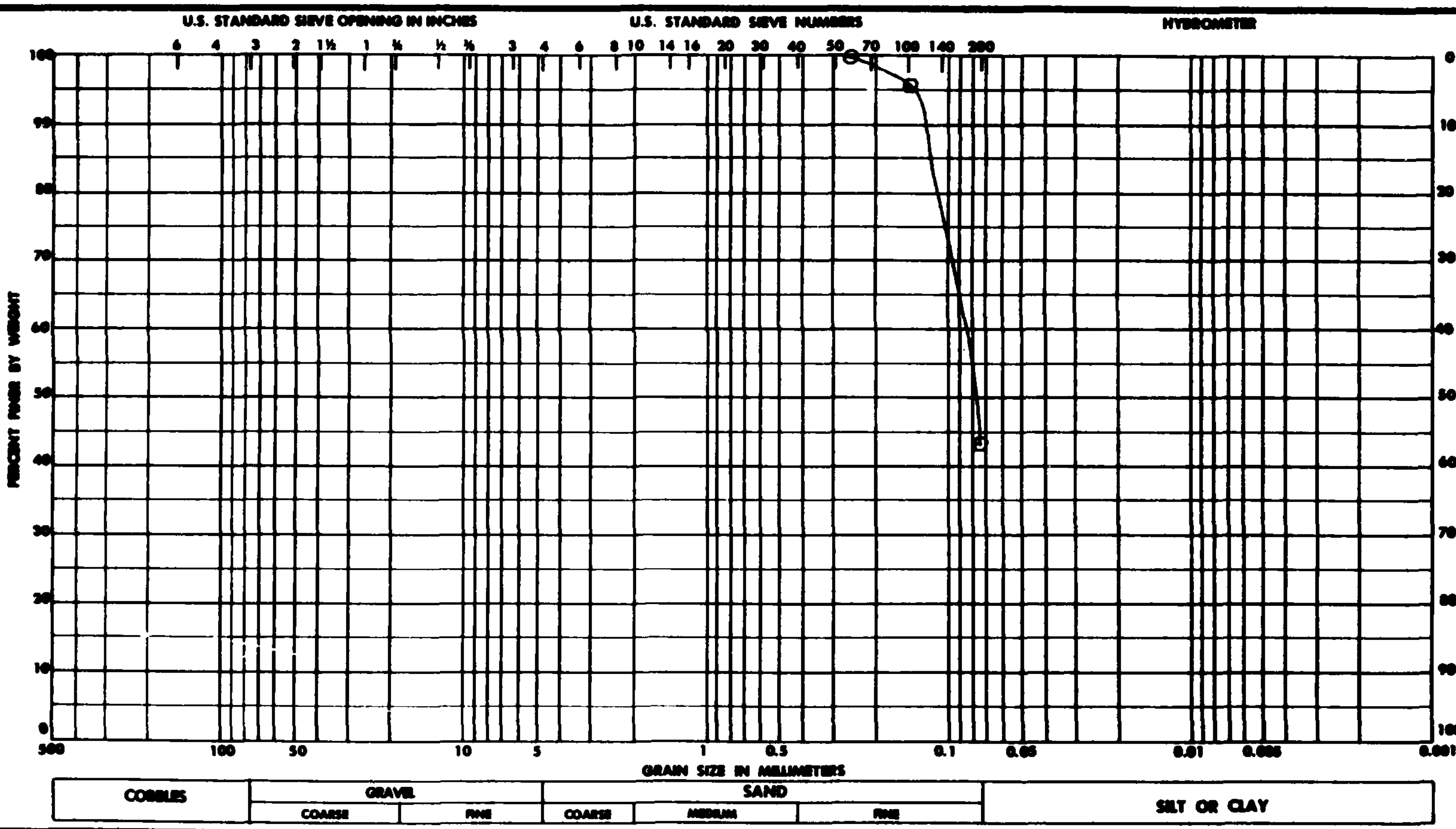
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev or Depth	VISUAL Classification	Nat w %	LL	PL	PI
3		CLASS. NOT REQUESTED	--	--	--	--

Project BAYOU LA TRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3328

Boring No. VBL-4-87 , SAMPLE 3

Date 09/23/87

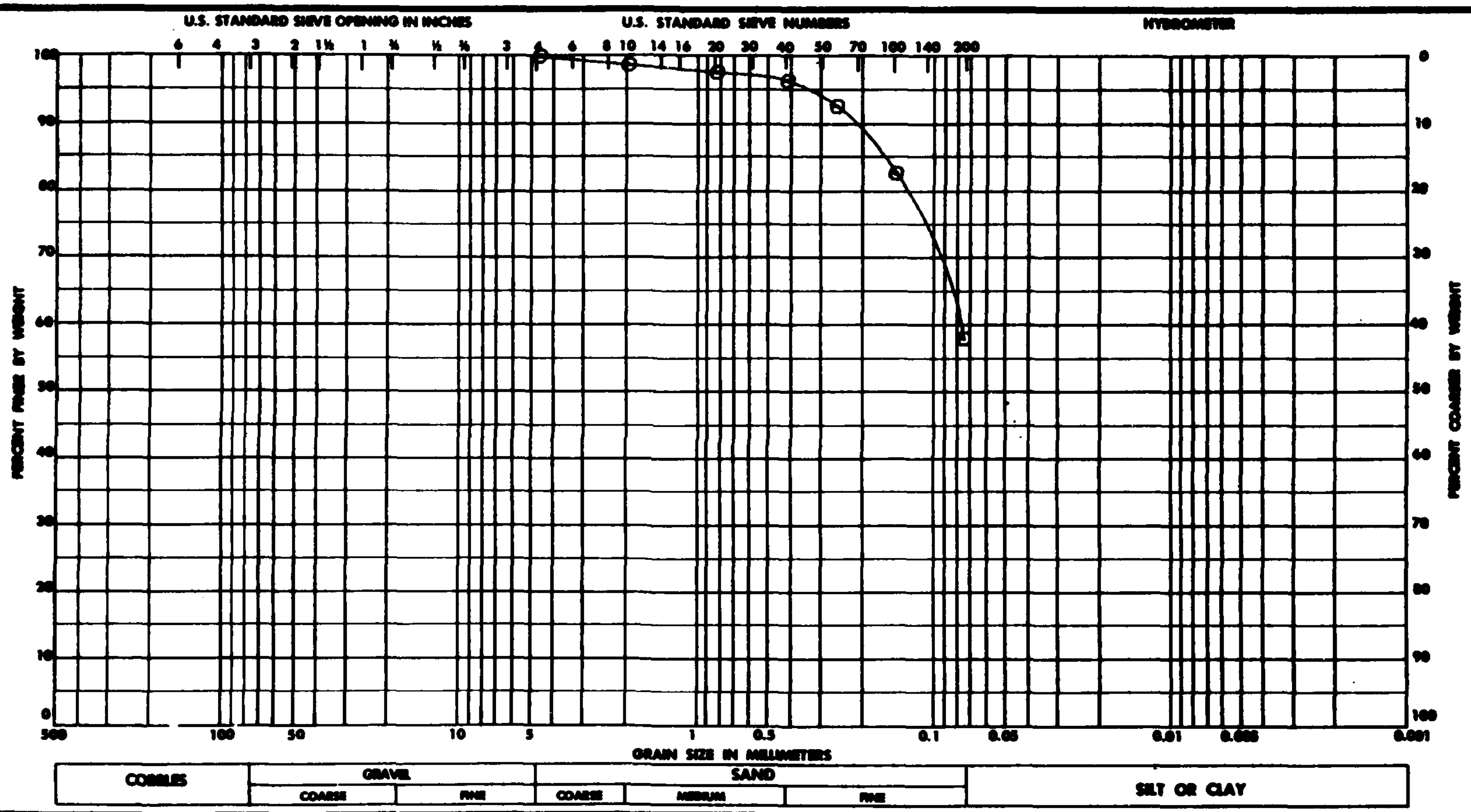
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Depth	VISUAL Classification	Nat w %	LL	PL	PI
4		CLASS. NOT REQUESTED	--	--	--	--

GRADATION CURVES

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3333

Boring No. VBL-5-87 .SAMPLE 4

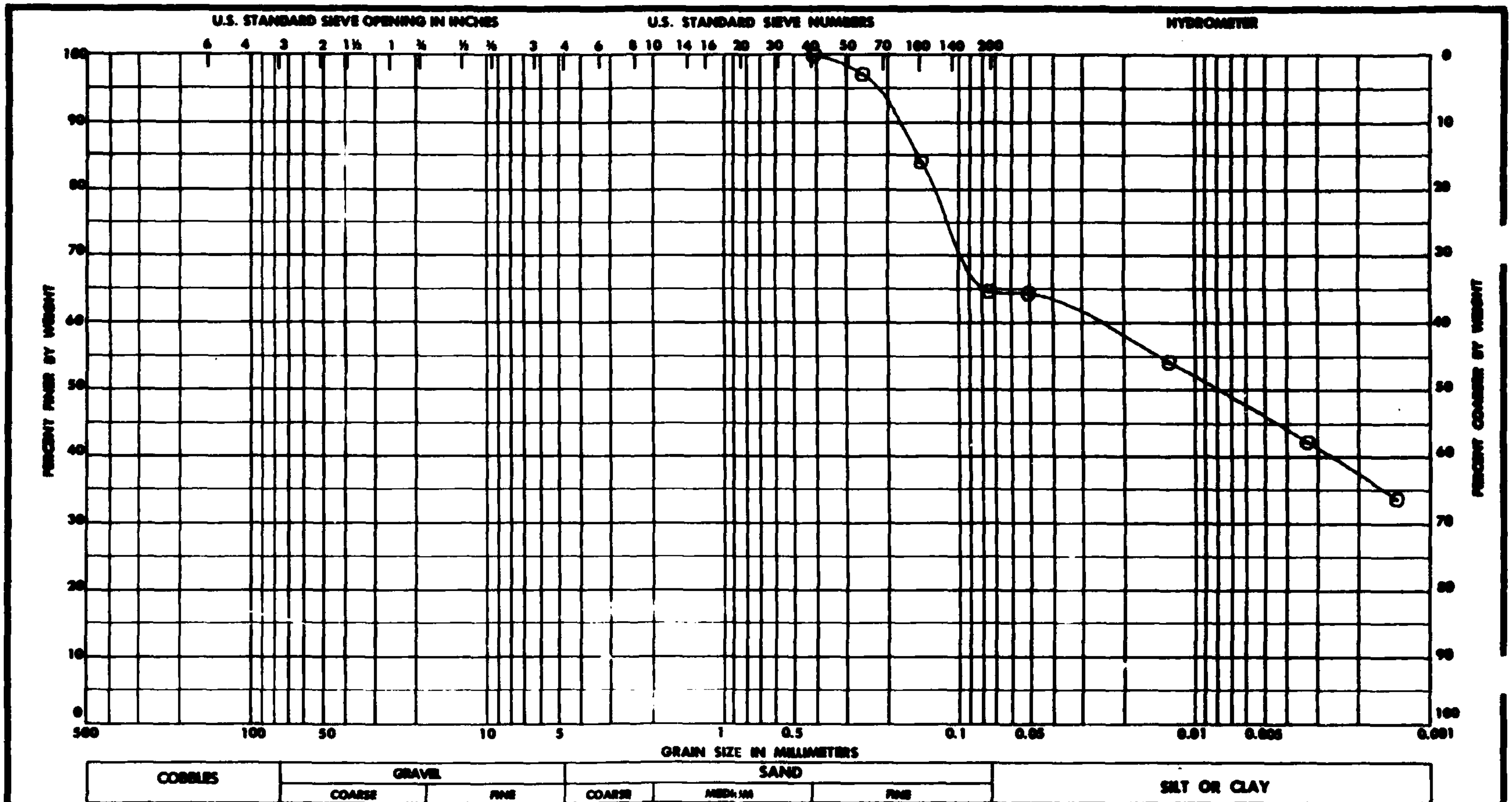
Date 09/23/87

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
1		FAT CLAY (CH)	103.3	71	17	54
		GREENISH GRAY, SANDY, W/A				
		TRACE OF MICA				
		SPECIFIC GRAVITY=2.65				

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3334

Boring No. VBL-6-87 , SAMPLE 1

Date 09/23/87

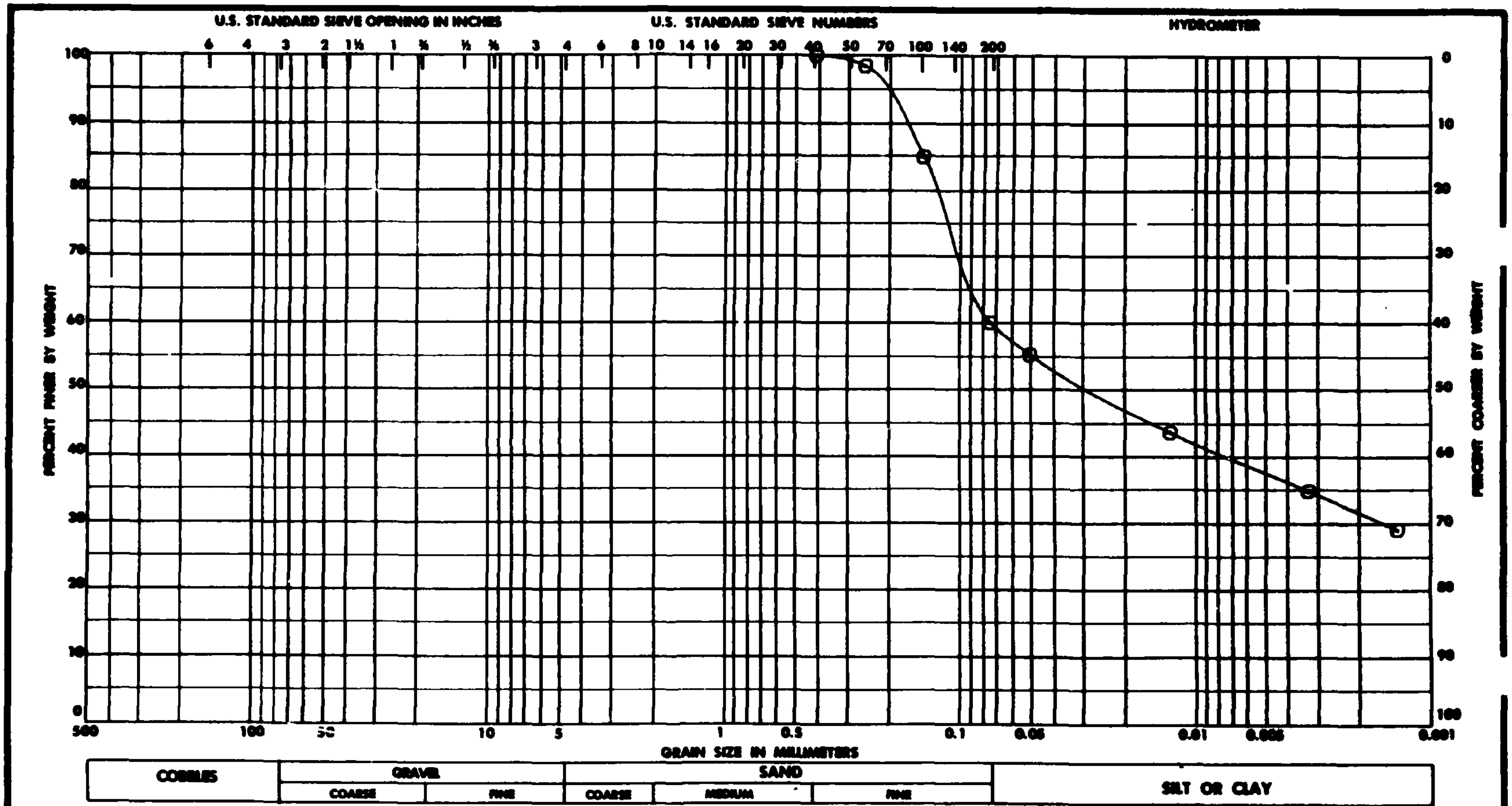
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
1		FAT CLAY (CH)	74.4	59	16	43
		GREENISH GRAY, SANDY, W/A				
		TRACE OF MICA				

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3341

Boring No. VBL-8-87 , SAMPLE 1

Date 09/23/87

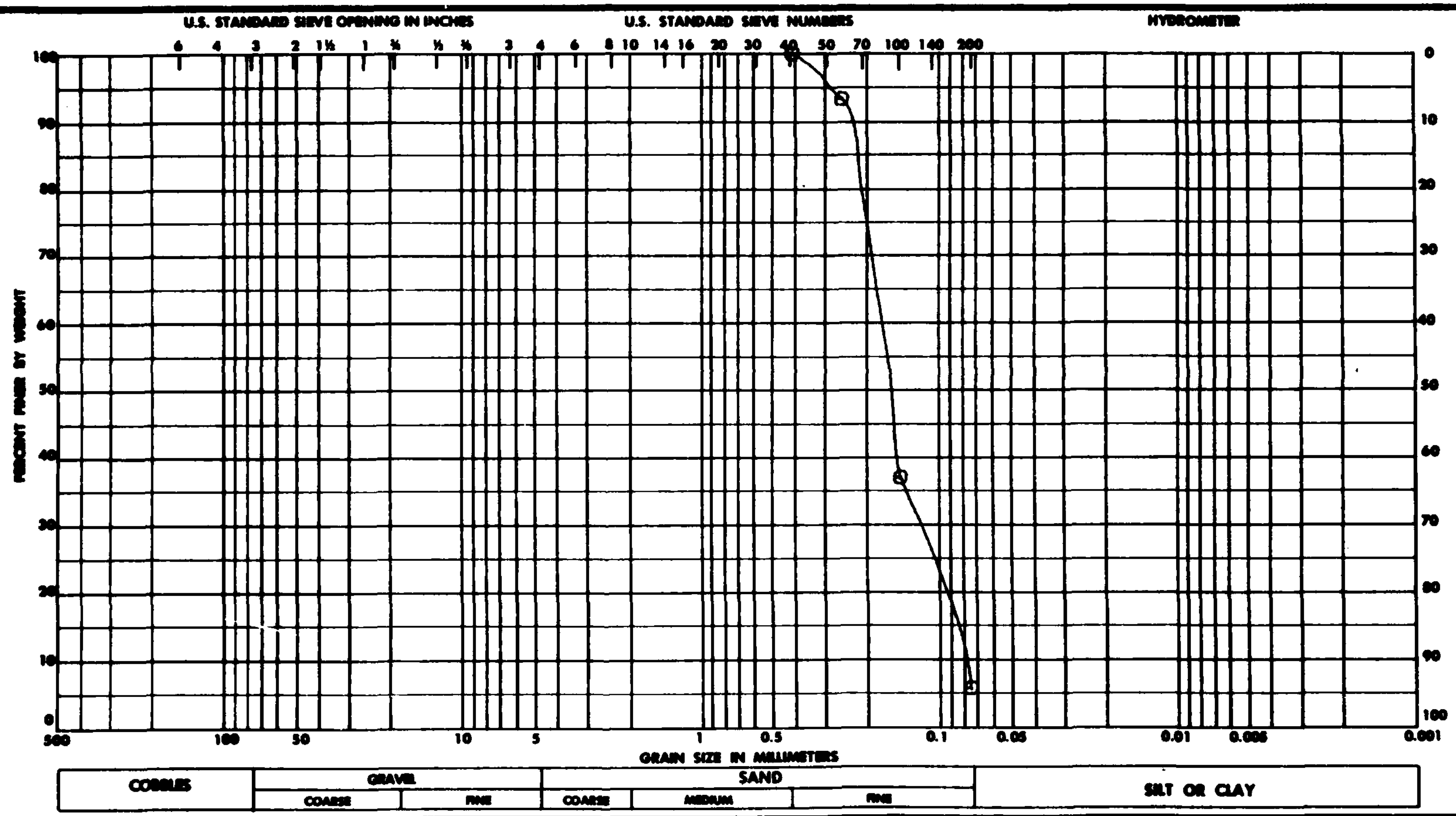
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	~~Elev~~ Depth	VISUAL Classification	Nat w %	LL	PL	PI
3		CLASS. NOT REQUESTED	--	--	--	--

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3343

Boring No. VBL-8-87 .SAMPLE 3

Date 09/23/87

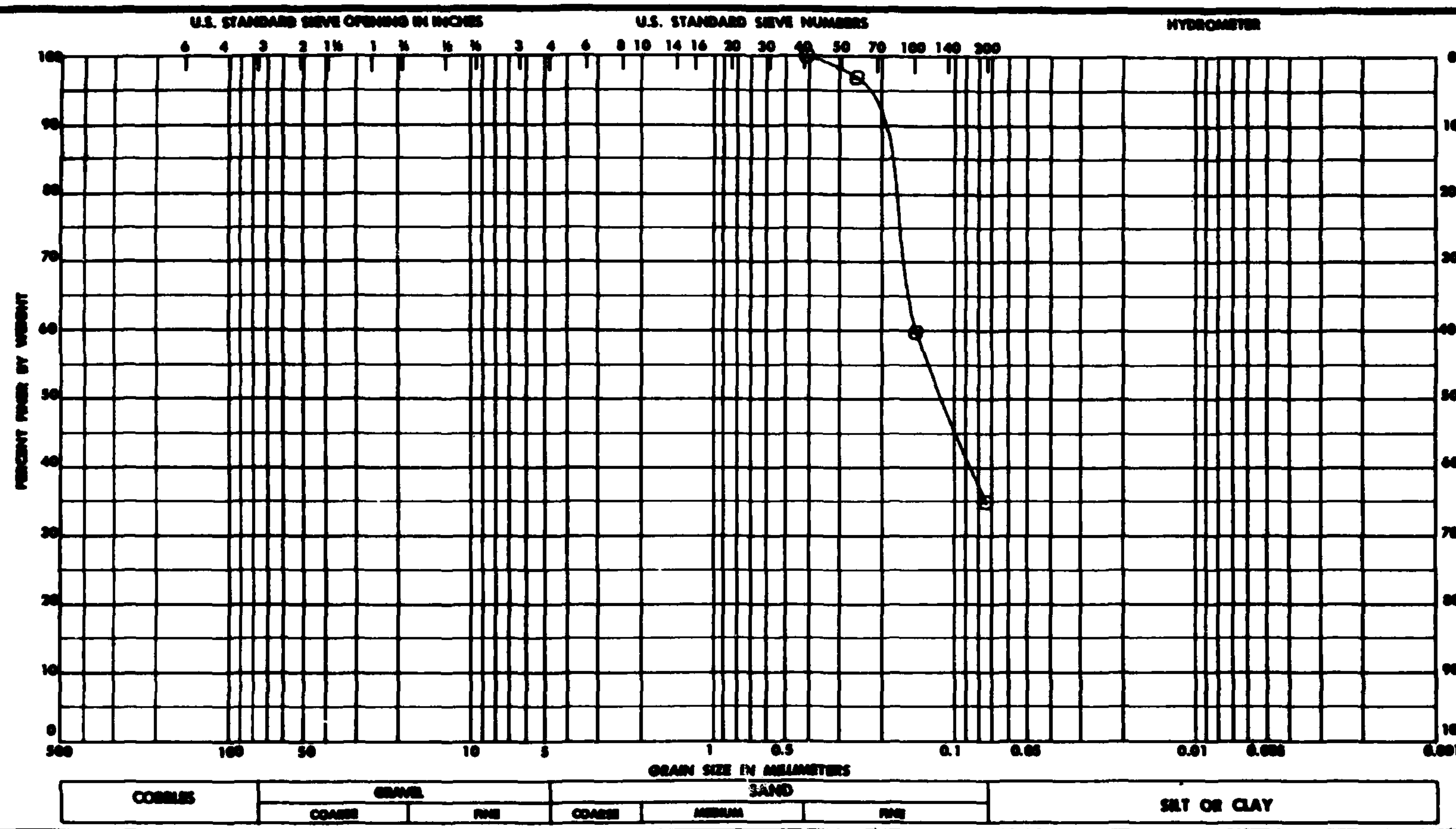
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev or Depth	VISUAL Classification	Nat w %	LL	PL	PI
3		CLAYEY SAND (SC)	--	--	--	--
		LT. GRAY, MICAEOUS				

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3346

Boring No. VBL-9-87 .SAMPLE 3

Date 09/23/87

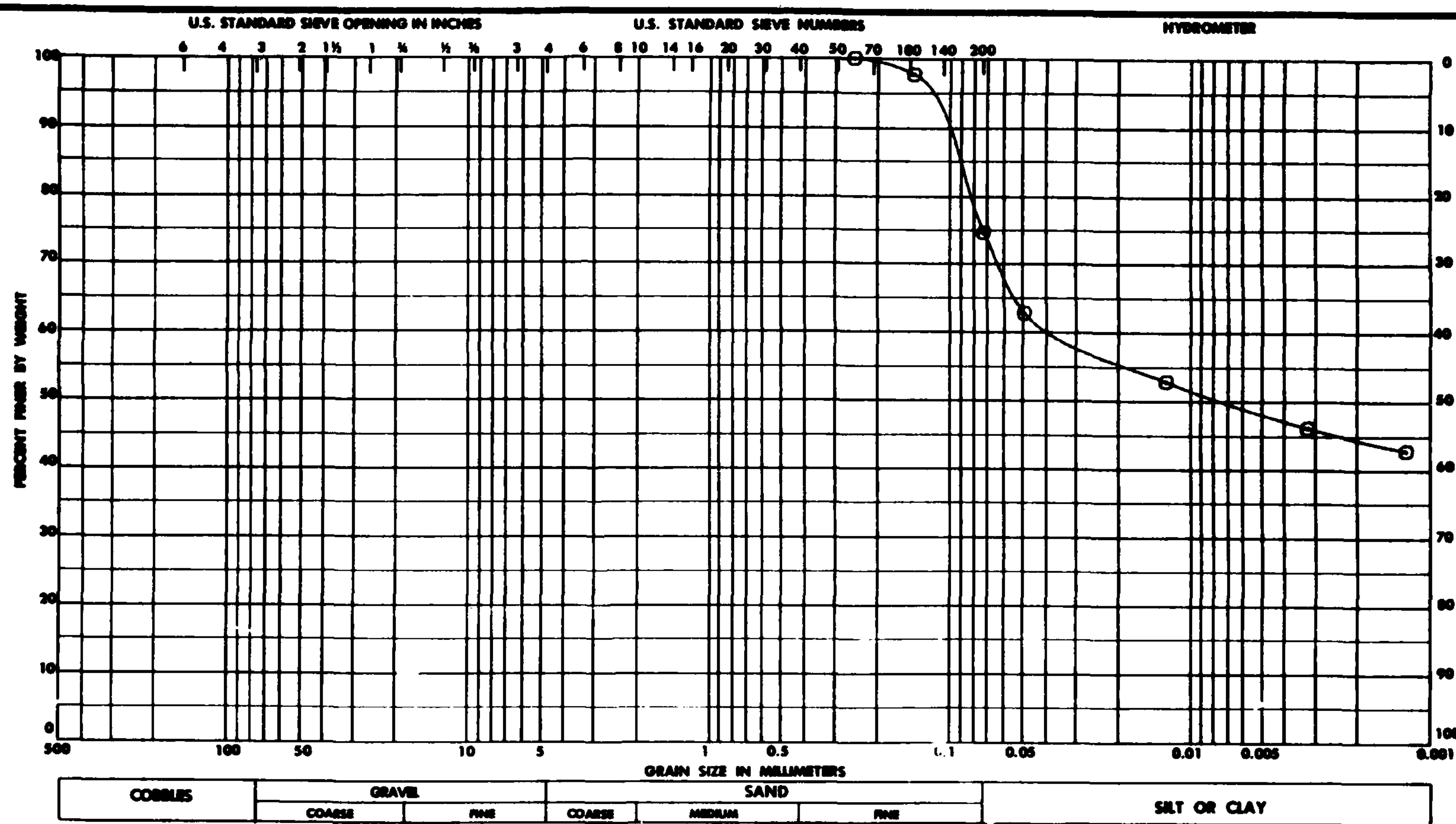
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
--	16.5-19.5'	FAT CLAY (CH)	98.3	79	20	59
	-17 -20	GRAY. W/SOME SAND				
		SPECIFIC GRAVITY=2.70				
		L.O.I.=11.6				
		UNIT WTD.=40.3PCF				

Project BAYOU LA BATRE
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3359A

Boring No. VBL-15-87 .SAMPLE -

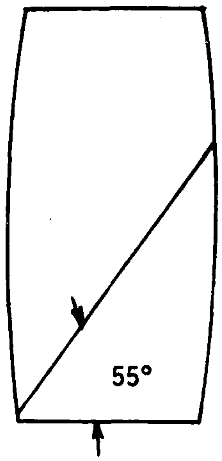
Date 10/01/87

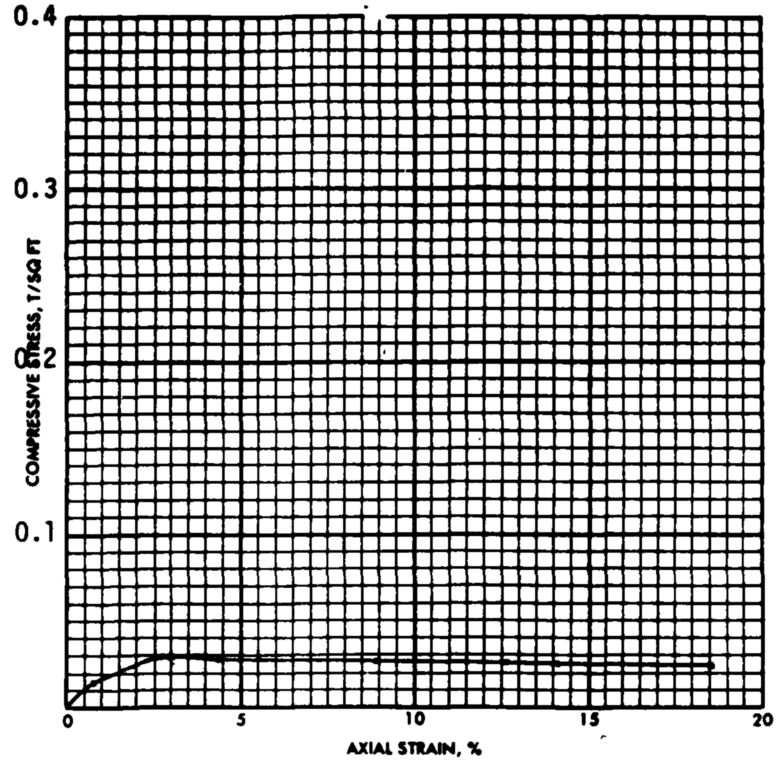
GRADATION CURVES

ENG FORM 1 MAY 63 2087

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS, MARIETTA, GEORGIA
Requisition No. 40-87-F&M Work Order No. 5323

FAILURE SKETCHES





☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

TEST NO.			1			
TYPE OF SPECIMEN			Undisturbed			
INITIAL	WATER CONTENT	w_o	101.8 %	%	%	%
	VOID RATIO	e_o	2.699			
	SATURATION	S_o	100.0 %	%	%	%
	DRY DENSITY, LB/CU FT	γ_d	44.7			
TIME TO FAILURE, MIN		t_f	4			
UNCONFINED COMPRESSIVE STRENGTH, T/SQ FT		q_u	.029			
UNDRAINED SHEAR STRENGTH, T/SQ FT		s_u	.015			
Rate of Strain, %/Min			0.75			
INITIAL SPECIMEN DIAMETER, IN		D_o	138			
INITIAL SPECIMEN HEIGHT, IN.		H_o	308			

CLASSIFICATION (Visual)Dark gray fat clay (CH), w/organic material & a trace of sand

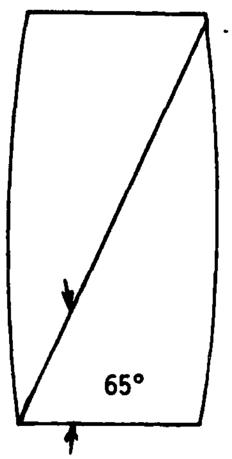
LL Not requested	PL --	PI --	G_s 2.65

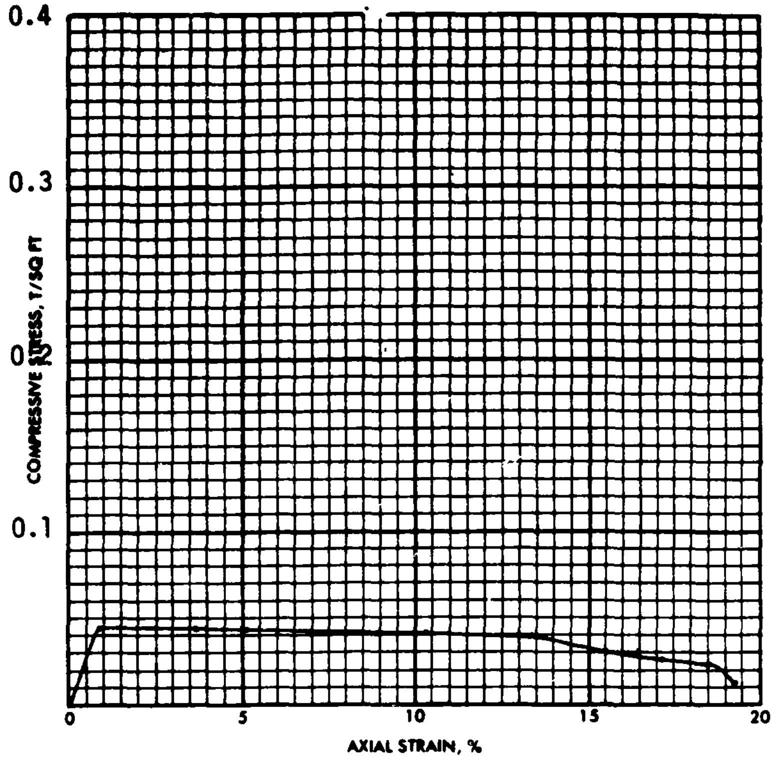
REMARKS	PROJECT MOBILE DISTRICT Bayou Labatre Channel and Harbor Deepening	
	AREA Lab No. 57/3359	
	BORING NO. VBL-15-87	SAMPLE NO. --
	EL 14'-17'	DATE 8 October 1987
	UNCONFINED COMPRESSION TEST REPORT	

ENG FORM 3659 1 JUN 65 (EM 1110-2-1906) (TRANSLUCENT) PLATE XI-2

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS, MARIETTA, GEORGIA
Requisition No. 40-87-F&M Work Order No. 5323

FAILURE SKETCHES





☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

TEST NO.			1			
TYPE OF SPECIMEN			Undisturbed			
INITIAL	WATER CONTENT	w_o	90.7 %	%	%	%
	VOID RATIO	e_o	2.484			
	SATURATION	S_o	98.6 %	%	%	%
	DRY DENSITY, LB/CU FT	γ_d	48.4			
TIME TO FAILURE, MIN		t_f	1			
UNCONFINED COMPRESSIVE STRENGTH, T/SQ FT		q_u	0.044			
UNDRAINED SHEAR STRENGTH, T/SQ FT		s_u	0.022			
~~SENSITIVITY RATIO~~ Rate of Strain, %/Min		~~S_t~~	0.75			
INITIAL SPECIMEN DIAMETER, IN		D_o	1.38			
INITIAL SPECIMEN HEIGHT, IN.		H_o	3.08			

CLASSIFICATION Fat clay (CH), gray, with some sand

LL	PL	PI	G_s
79	20	59	2.70

REMARKS 1. See lab classification data on ENG Form 2087.
2. Loss on ignition = 11.6

PROJECT MOBILE DISTRICT
Bayou Labatre Channel and Harbor Deepening

AREA Lab No. 57/3359A

BORING NO. VBL-15-87 SAMPLE NO.

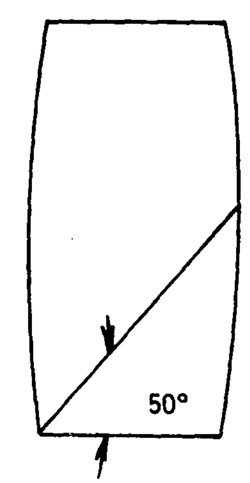
~~DEPTH~~ EL -17-20 DATE 8 October 1987

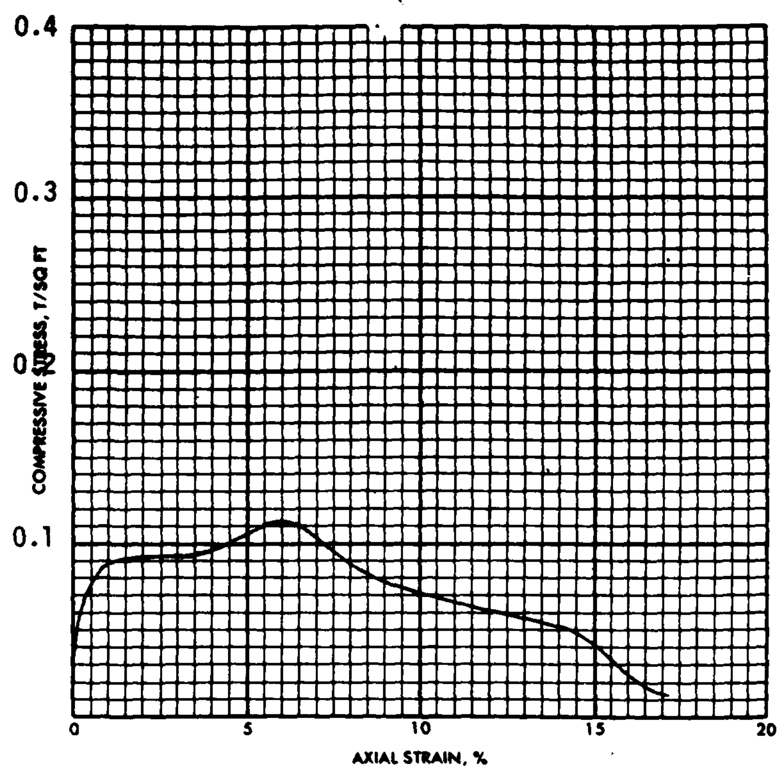
UNCONFINED COMPRESSION TEST REPORT

ENG FORM 3659 1 JUN 66 (EM 1110-2-1906) (TRANSLUCENT) GPO 1966 OF-214-946 PLATE XI-2

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS, MARIETTA, GEORGIA
Work Order No. 5323
Requisition No. 40-87-F&M

FAILURE SKETCHES





☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

TEST NO.		1			
TYPE OF SPECIMEN		Undisturbed			
INITIAL — WATER CONTENT	w_o	75.0 %	%	%	%
INITIAL — VOID RATIO	e_o	2.053			
INITIAL — SATURATION	S_o	98.2 %	%	%	%
INITIAL — DRY DENSITY, LB/CU FT	γ_d	55.0			
TIME TO FAILURE, MIN	t_f	8			
UNCONFINED COMPRESSIVE STRENGTH, T/SQ FT	q_u	0.112			
UNDRAINED SHEAR STRENGTH, T/SQ FT	s_u	.056			
~~SENSITIVITY RATIO~~ Rate of Strain,%/Min	~~S_t~~	0.75			
INITIAL SPECIMEN DIAMETER, IN	D_o	1.38			
INITIAL SPECIMEN HEIGHT, IN.	H_o	3.08			

CLASSIFICATION (Visual)Dark gray fat clay(CH),w/organic material and a trace of sand

LL Not requested | PL -- | PI -- | G_s 2.69

REMARKS

PROJECT MOBILE DISTRICT
Bayou Labatre Channel and Harbor Deepening

AREA Lab No. 57/3359B

BORING NO. VBL-15-87 | SAMPLE NO. --

~~DEPTH~~ EL -20-23 | DATE 8 October 1987

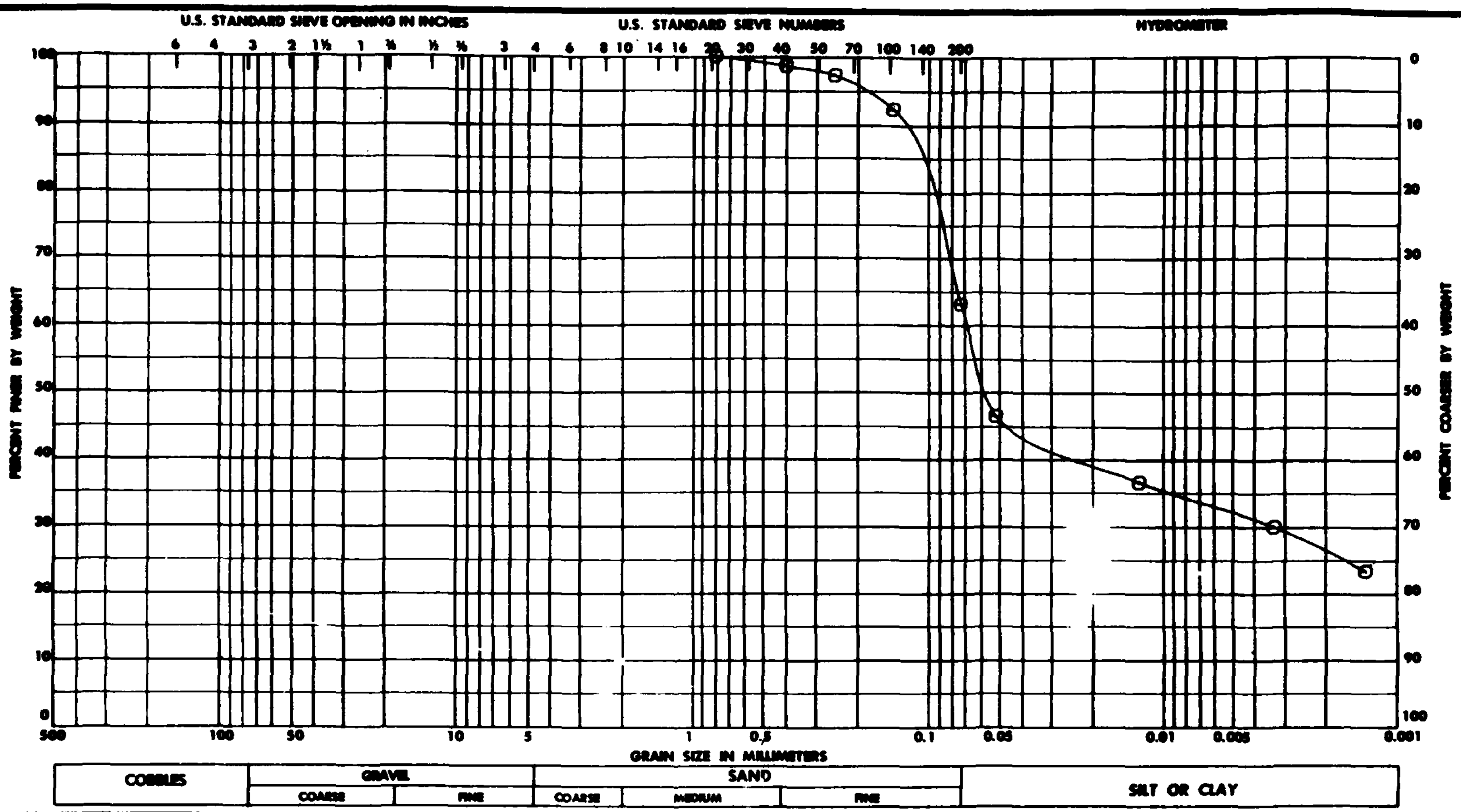
UNCONFINED COMPRESSION TEST REPORT

ENG FORM 1 JUN 65 3659 (EM 1110-2-1906) (TRANSLUCENT) GPO 1966 OF—214-946 PLATE XI-2

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
-	15.7-18.7'	FAT CLAY (CH)	98.5	[illegible]7	15	52
		GRAY, SANDY, W/A TRACE OF				
		SHELL & MICA				
		SPECIFIC GRAVITY=2.65				
		UNIT WID=58.6PCF				

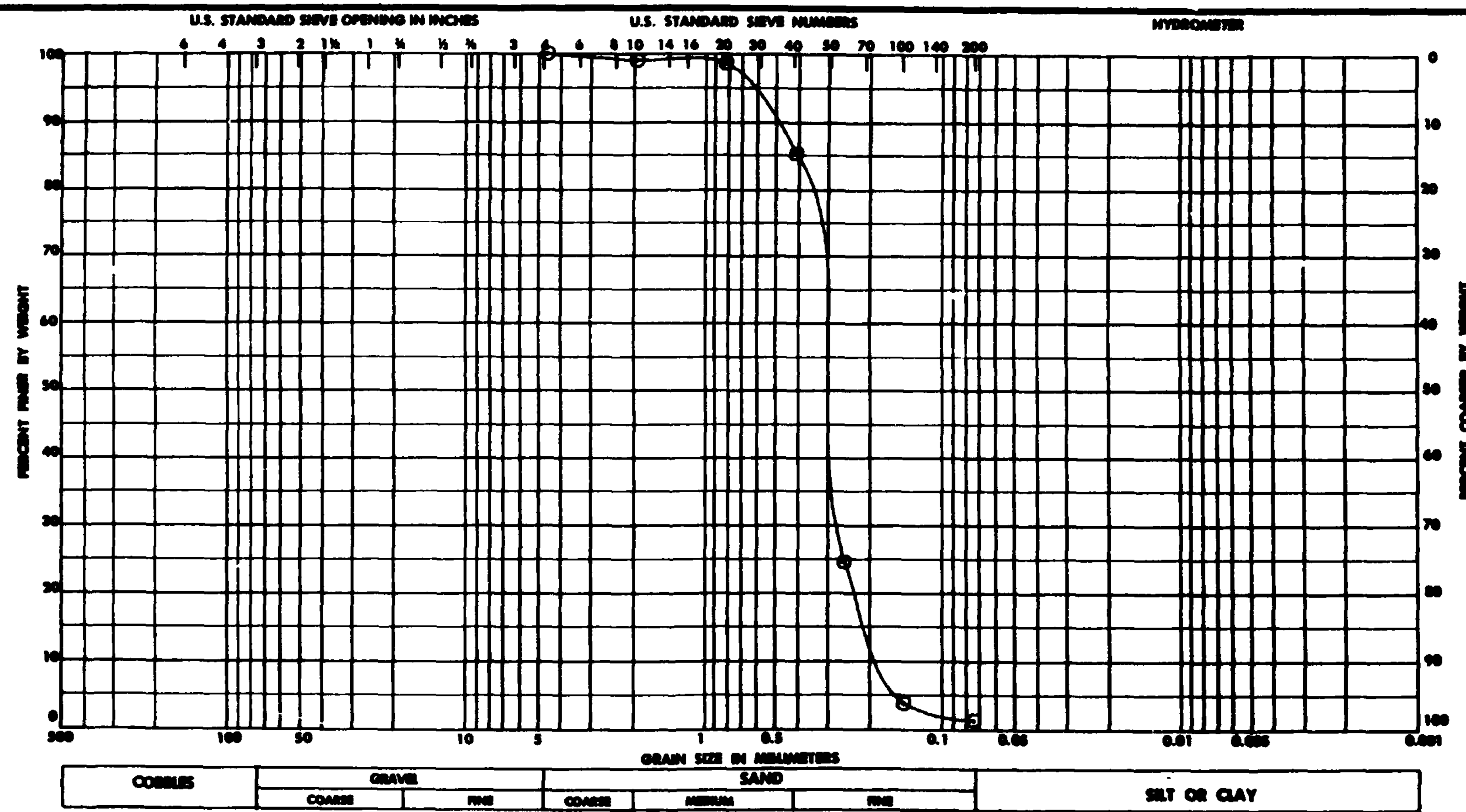
Project	BAYOU LA BATRE
	CHANNEL & HARBOR DEEPENING
Area	LAB NO. 57/3379
Boring No.	VBL-22-87 .SAMPLE
Date	10/01/87

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
1		VISUAL POORLY GRDED SAND (SP) GRAY. W/A TRACE OF SHELL FRAGMENTS	--	--	--	--

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3381

Boring No. VBL-23-87 , SAMPLE 1

Date 09/23/87

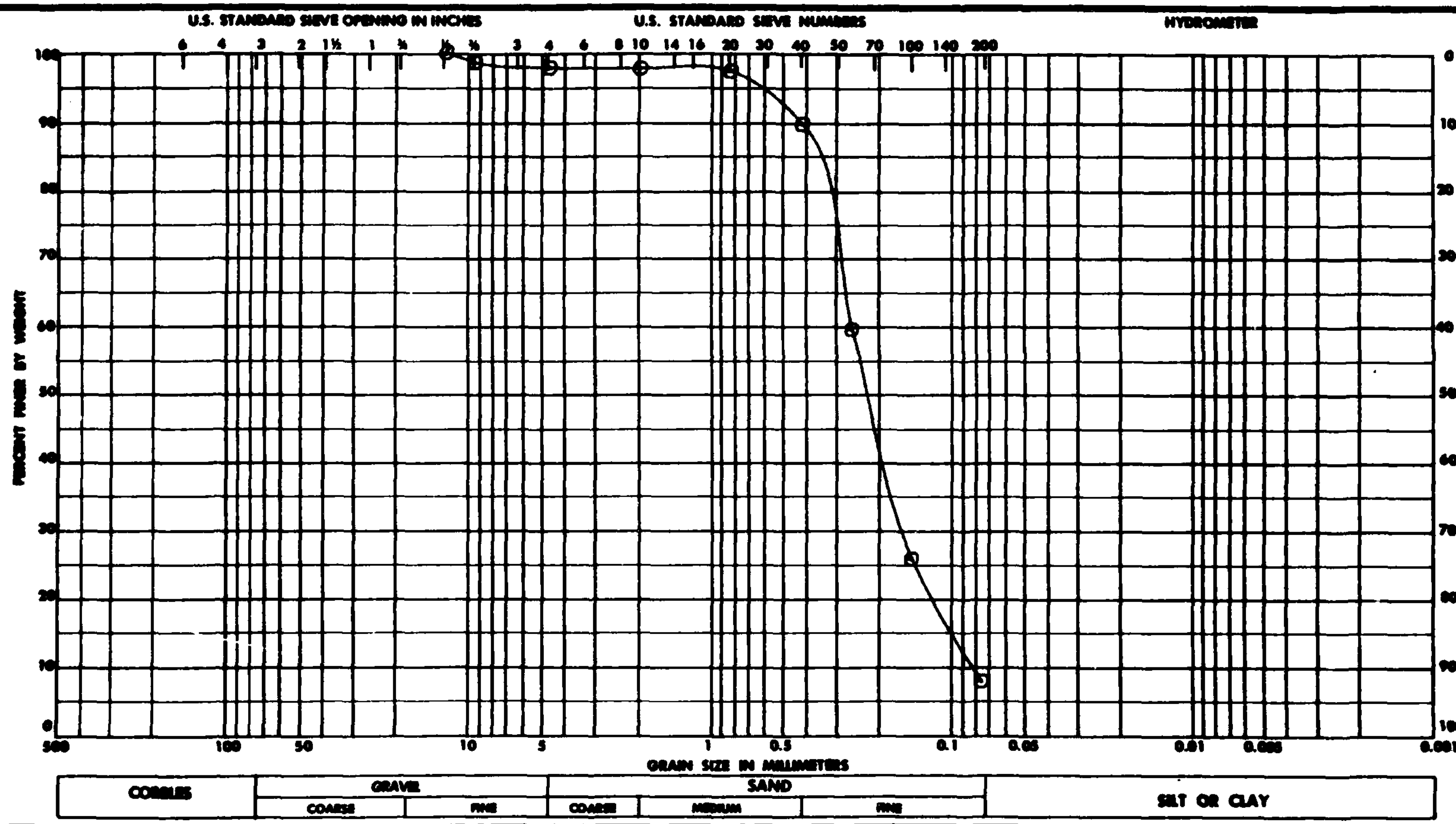
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Depth	VISUAL Classification	Nat w %	LL	PL	PI
1		CLASS. NOT REQUESTED	--	--	--	--
		.				

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3384

Boring No. VBL-24-87 .SAMPLE 1

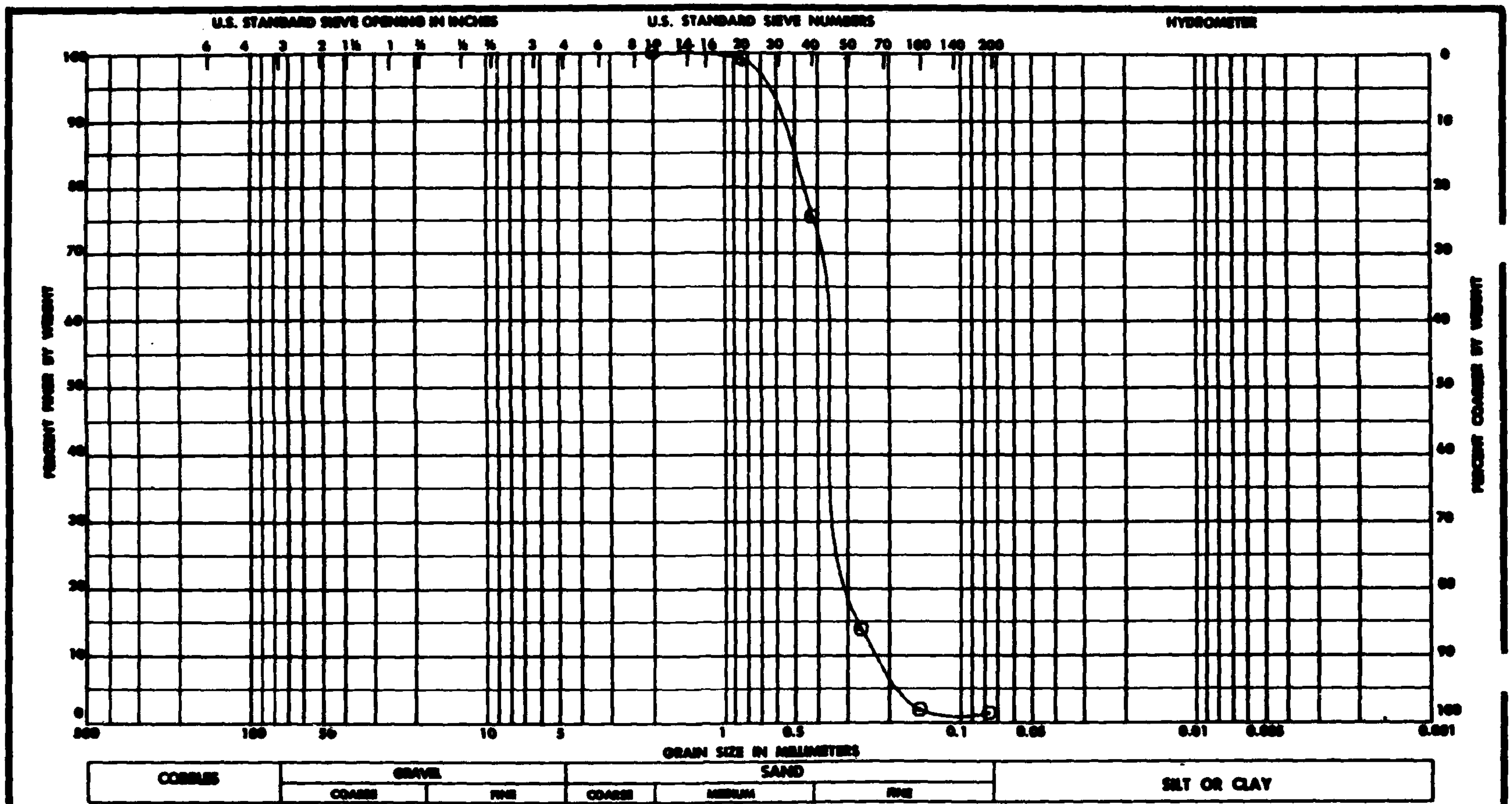
Date 09/23/87

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Depth	Classification	Nat w %	LL	PL	PI
1		VISUAL POORLY GRDED SAND (SP) GRAY. W/A TRACE OF MICA	--	--	--	--

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3387

Boring No. VBL-25-87 .SAMPLE 1

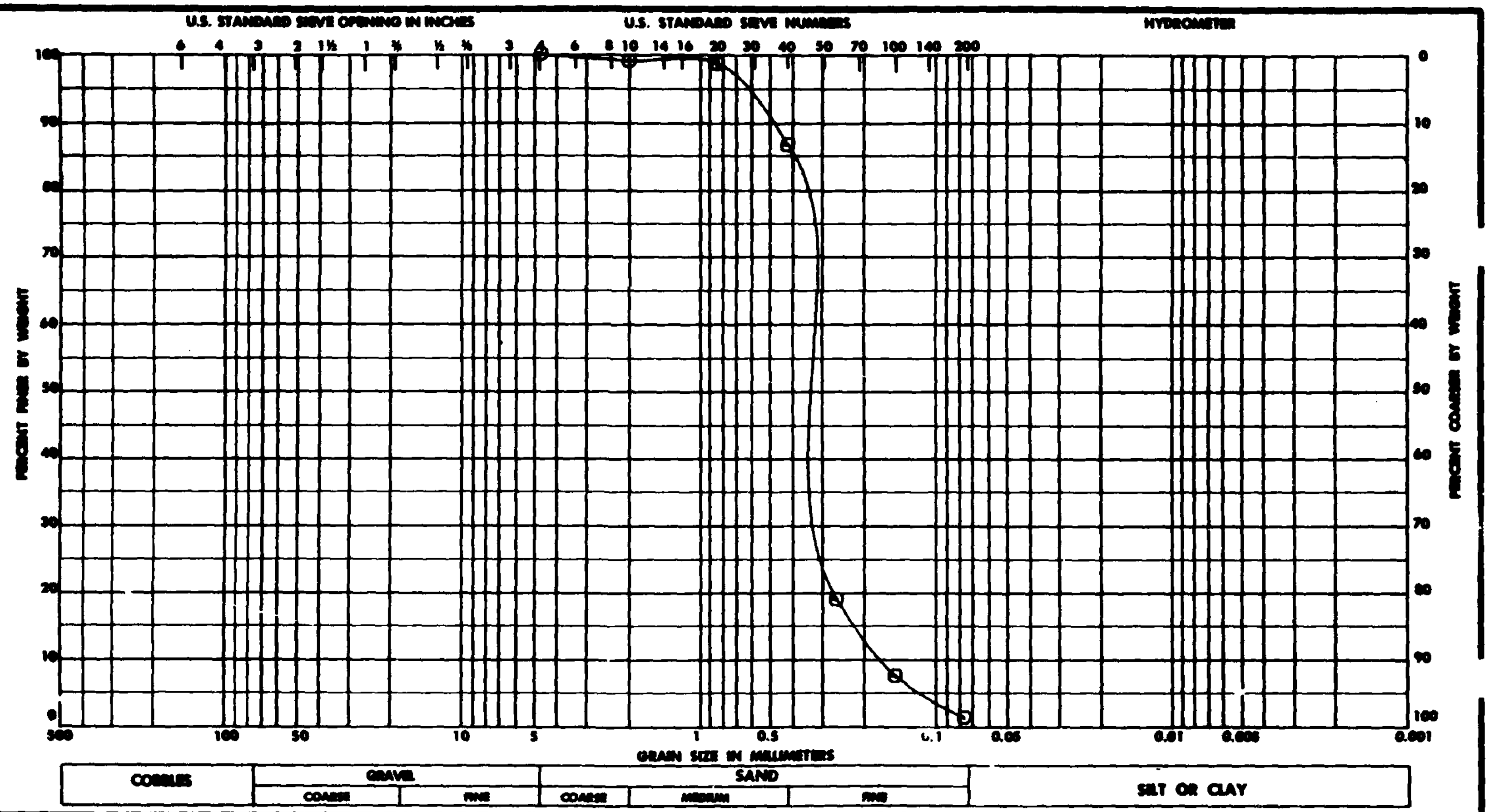
Date 09/23/87

GRADATION CURVES

ENG FORM, 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323
Req. No. 40-87-F&M



Sample No.	Depth	Classification	Nat w %	LL	PL	PI
1		VISUAL POORLY GRDED SAND (SP) GRAY. W/A TRACE OF SHELL FRAGMENTS	--	--	--	--

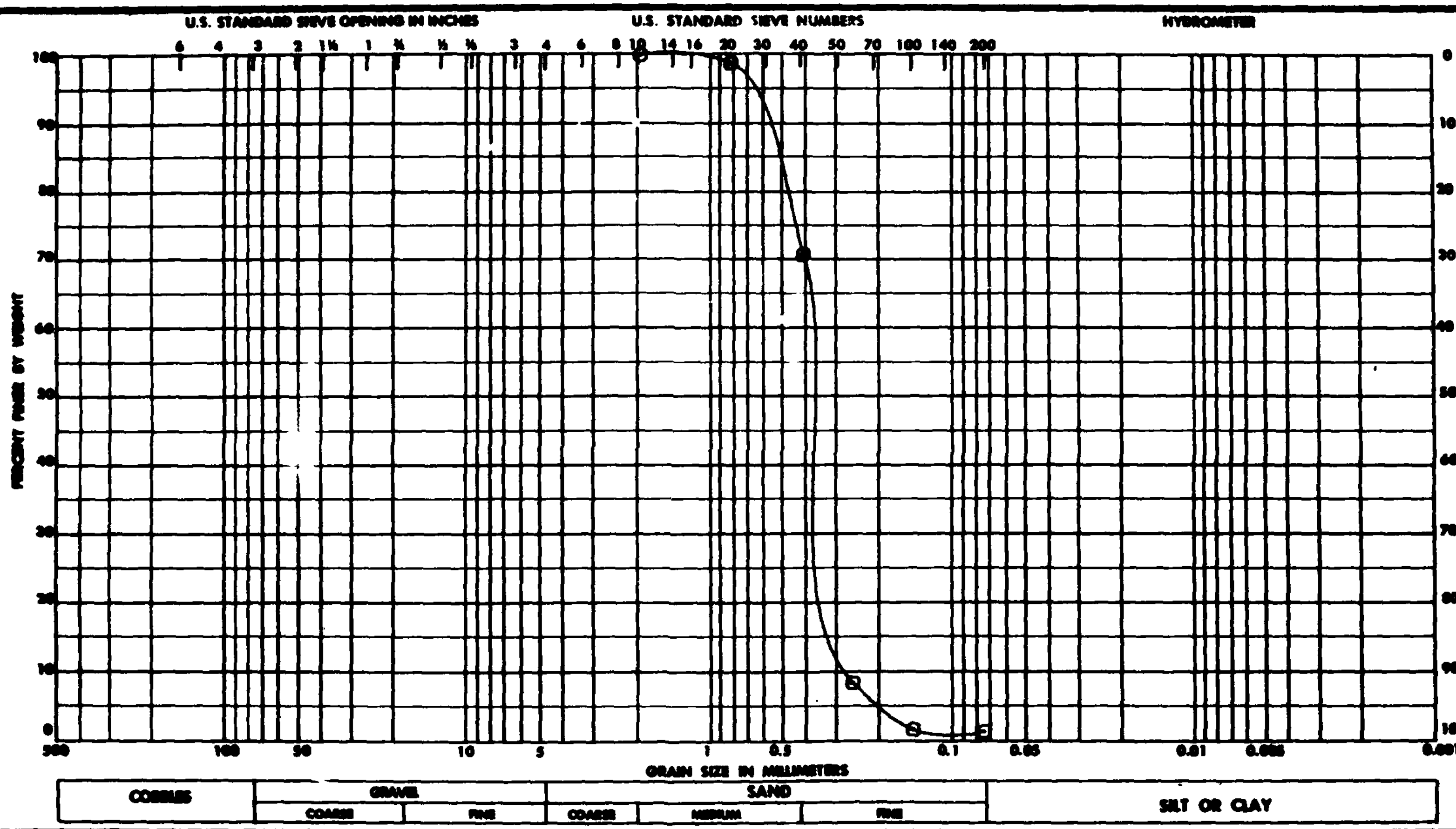
Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING
Area LAB NO. 57/3389
Boring No. VBL-26-87 .SAMPLE 1
Date 09/23/87

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
--	7.2-10.2'	VISUAL POORLY GRADED SAND (SP) GRAY. W/A TRACE OF SHELL FRAGMENTS	--	NP	NP	NP

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3390

Boring No. VBL-27-87 , SAMPLE -

Date 09/28/87

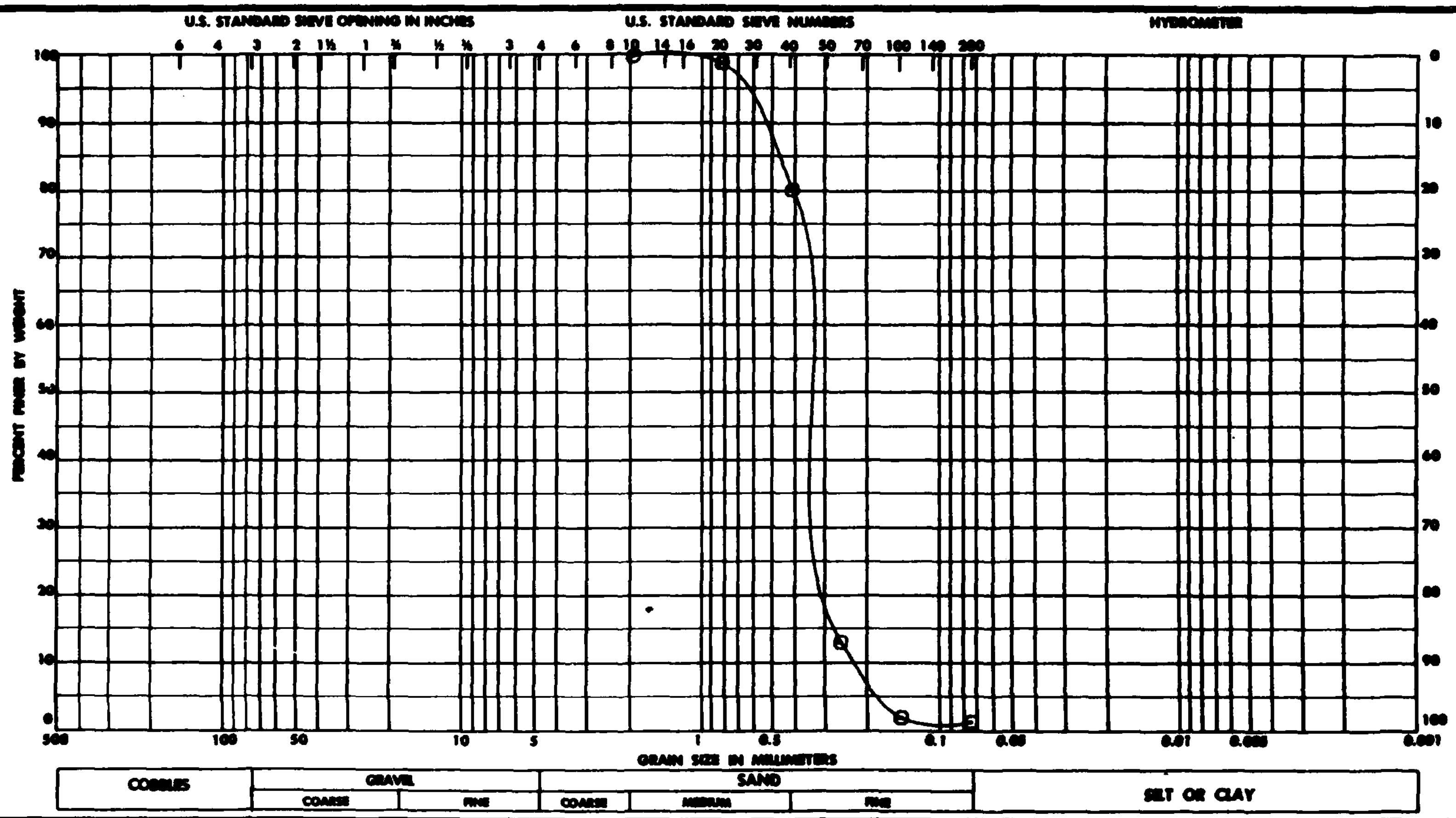
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev or [illegible]	VISUAL Classification	Nat w %	LL	PL	PI
-	10.2-13.2'	POORLY GRADED SAND (SP)	18.3	NP	NP	NP
		GRAY, W/A TRACE OF SHELL				
		FRAGMENTS				
		UNIT WTD=105.4PCF				
		SPECIFIC GRAVITY = 2.62				

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3390A

Boring No. VBL-27-87 , SAMPLE -

Date 09/28/87

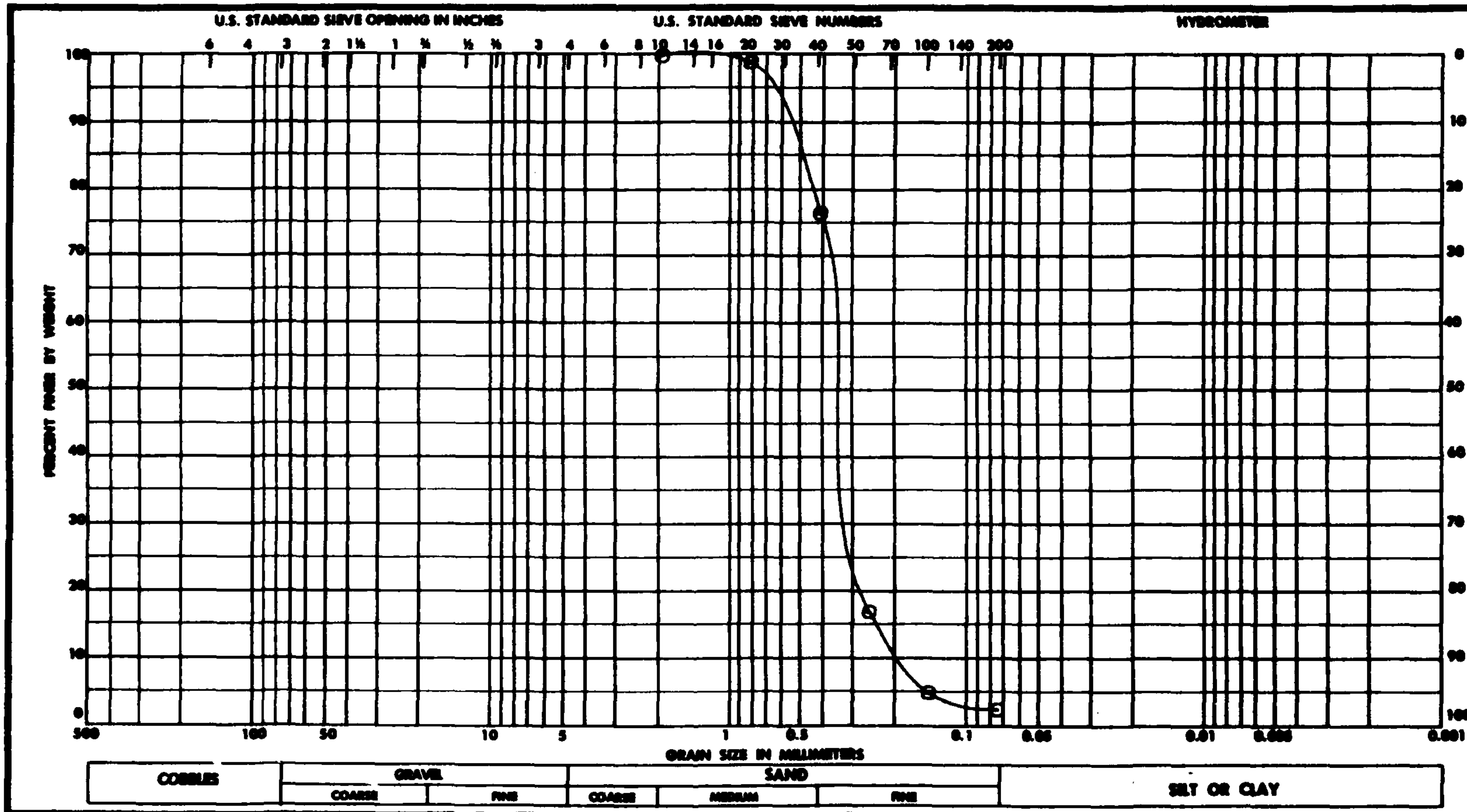
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
-	13.2-16.2'	VISUAL POORLY GRADED SAND (SP) GRAY. W/A TRACE OF SHELL FRAGMENT UNIT WTD=106.2PCF	16.8	NP	NP	NP

Project	BAYOU LA BATRE CHANNEL CHANNEL & HARBOR DEEPENING
Area	LAB NO. 57/3390B
Boring No.	VBL-27-87 . SAMPLE -
Date	09/28/87

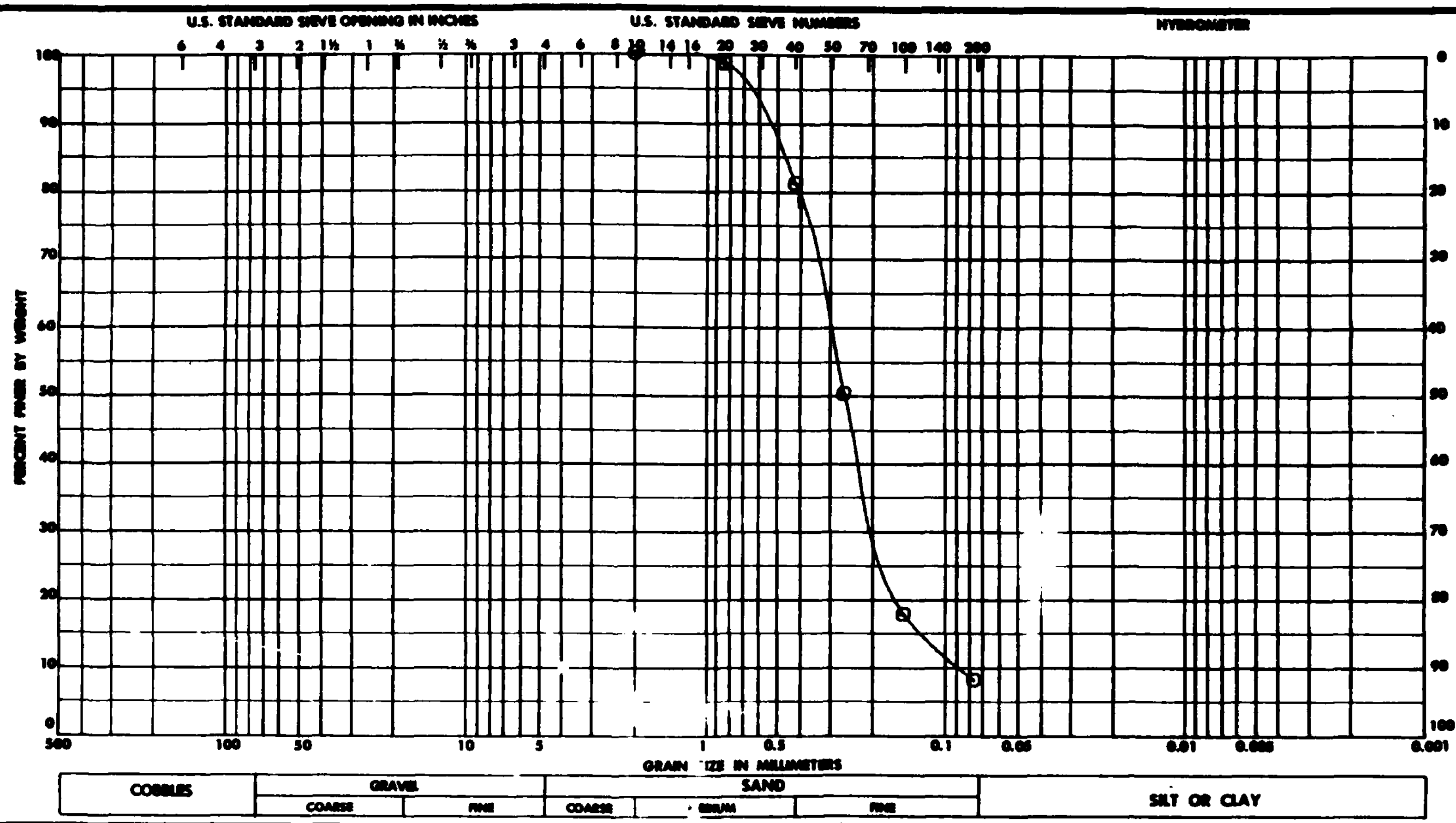
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Depth	VISUAL Classification	Nat w %	LL	PL	PI
2		CLASS. NOT REQUESTED	--	--	--	--

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3395

Boring No. VBL-29-87 . SAMPLE 2

Date 09/23/87

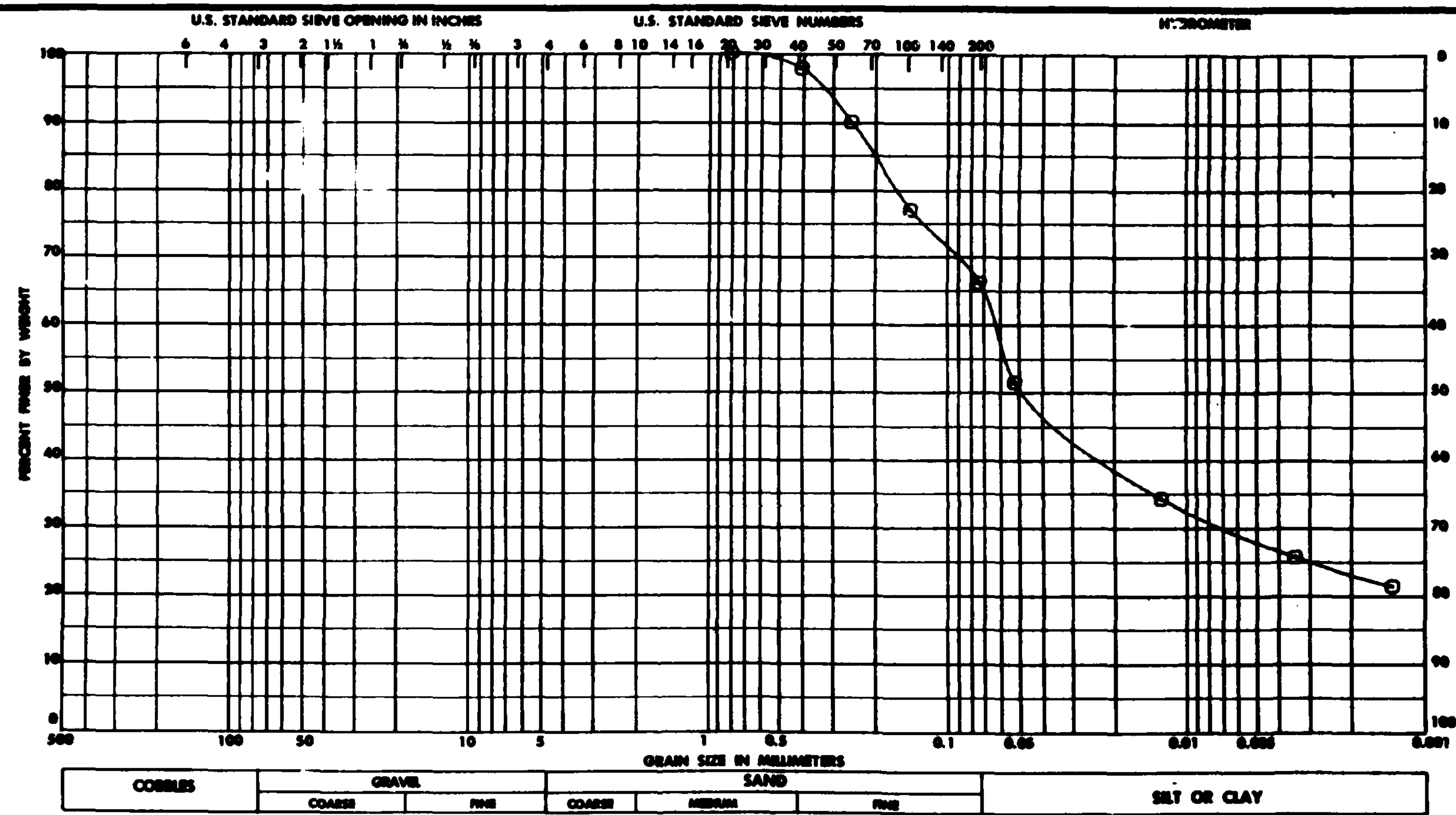
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
-	17.1 - 20.1	FAT CLAY (CH)	157.2	82	24	58
		GRAY. W/SOME SAND. & TRACES				
		OF WOOD CHIPS				
		SPECIFIC GRAVITY=2.53.				
		L.O.I.=10.2. UNIT WT.=26.7 pcf				

Project: BAYOU LA BATRE
CHANNEL & HARBOR DEEPENING

Area: LAB NO. 57/3398

Boring No. VBL-30-87 . SAMPLE -

Date: 10/01/87

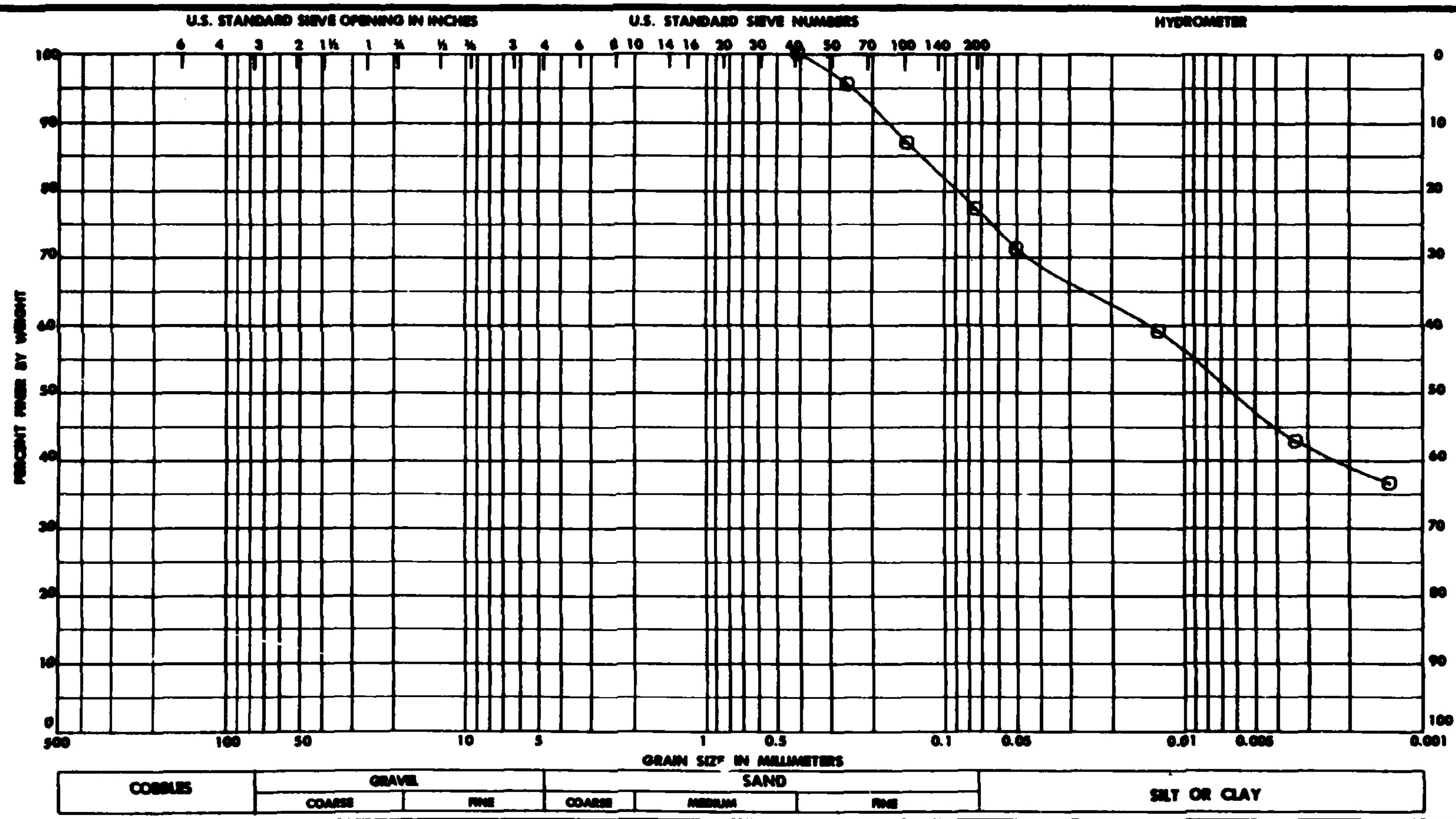
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
--	14.4 - 18.2	FAT CLAY (CH)	143.9	92	26	66
		GRAY. W/SOME SAND & TRACES OF				
		WOOD CHIPS				
		L.O.I=9.7				
		UNIT WTD=30.6 PCF				

Project: BAYOU LA BATRE
CHANNEL & HARBOR DEEPENING

Area: LAB NO. 57/3405

Boring No. VBL-32-87 .SAMPLE -

Date: 10/01/87

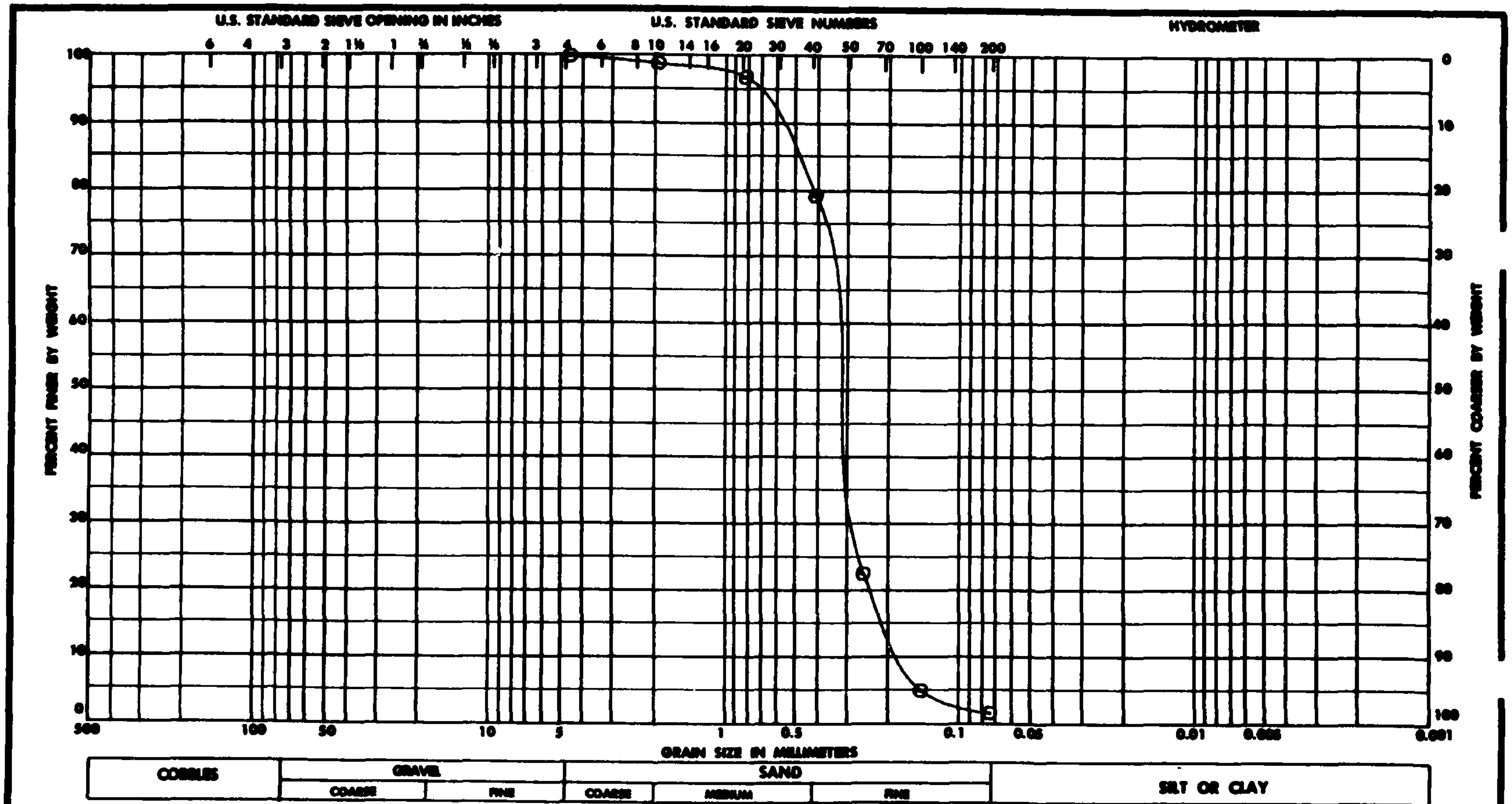
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
-	18.2 - 21.3	VISUAL POORLY GRADED SAND (SP) GRAY. W/A TRACE OF SHELL FRAGMENTS	20.6	NP	NP	NP

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3405A

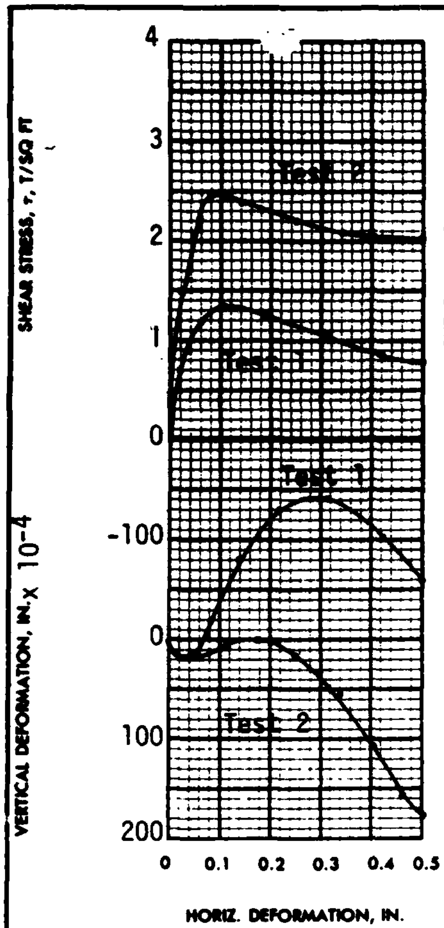
Boring No. VBL-32-87 . SAMPLE - 1

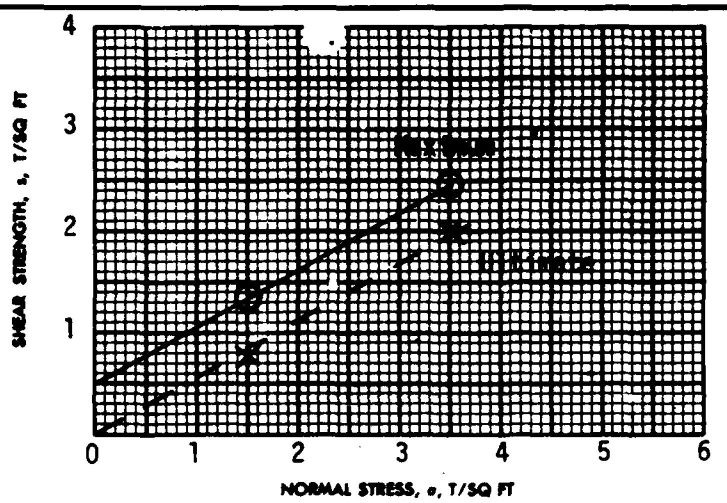
Date 09/28/87

GRADATION CURVES

ENG FORM 1 MAY 63 2087

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS, MARIETTA, GEORGIA
Work Order No. 5323
Requisition No. 40-87-F&M





TEST NO.			1	2		
INITIAL	WATER CONTENT	w_o	19.8 %	19.1 %	%	%
INITIAL	VOID RATIO	e_o	.640	.628		
INITIAL	SATURATION	S_o	81.7 %	80.3 %	%	%
INITIAL	DRY DENSITY, LB/CU FT	γ_d	100.4	101.2		
VOID RATIO AFTER CONSOLIDATION		e_c	.599	.547		
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}	2.0	6.0		
FINAL	WATER CONTENT	w_f	23.4 %	18.5 %	%	%
FINAL	VOID RATIO	e_f	.618	.489		
FINAL	SATURATION	S_f	100.0 %	100.0 %	%	%
NORMAL STRESS, T/SQ FT		σ	1.50	3.50		
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}	1.34	2.45		
ACTUAL TIME TO FAILURE, MIN		t_f	90	75		
RATE OF STRAIN, IN./MIN			.001	.001		
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}	0.77	2.01		

SHEAR STRENGTH PARAMETERS

	Maximum	Ultimate
ϕ' =	29.0	29.0
TAN ϕ' =	0.554	0.554
c' =	0.50*	0.0 T/SQ FT

*Apparent cohesion not recommended for design computations.

☐ CONTROLLED STRESS
☒ CONTROLLED STRAIN

TYPE OF SPECIMEN Vibracore — 3.0 IN. SQUARE — 0.50 IN. THICK

Visual CLASSIFICATION Gray poorly graded sand (SP), with a trace of shell fragments

LL	PL	PI		G_s
NP	NP	NP	--	2.64

REMARKS See gradation curve on ENG Form 2087.

PROJECT MOBILE DISTRICT - Bayou Labatre Channel and Harbor Deepening

AREA Lab No. 57/3405A

BORING NO. VBL-32-87 — SAMPLE NO. --

DEPTH, ft 19.2 - 21.3 — DATE 9 October 1987

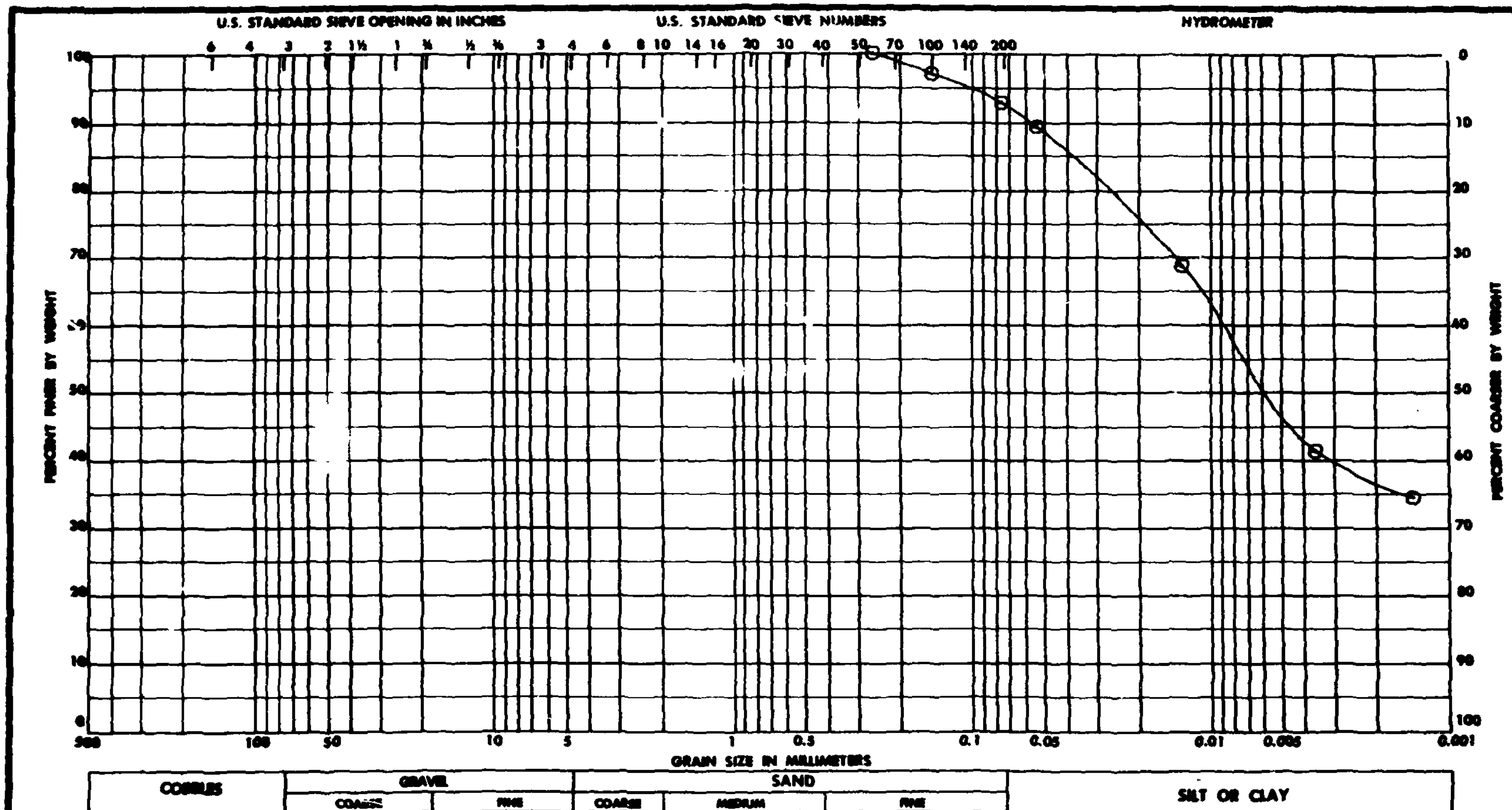
DIRECT SHEAR TEST REPORT

ENG FORM 2092, 1 JUN 66 (EM 1110-2-1906) PREVIOUS EDITIONS ARE OBSOLETE (TRANSLUCENT) PLATE IX-3

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Depth	VISUAL Classification	Nat w %	LL	PL	PI
1		CLASS. NOT REQUESTED	311.6	--	--	--
		.				
		L.O.I. = 11.8				

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING
Area LAB NO. 57/3407
Boring No. VBL-33-87 , SAMPLE 1
Date 09/23/87

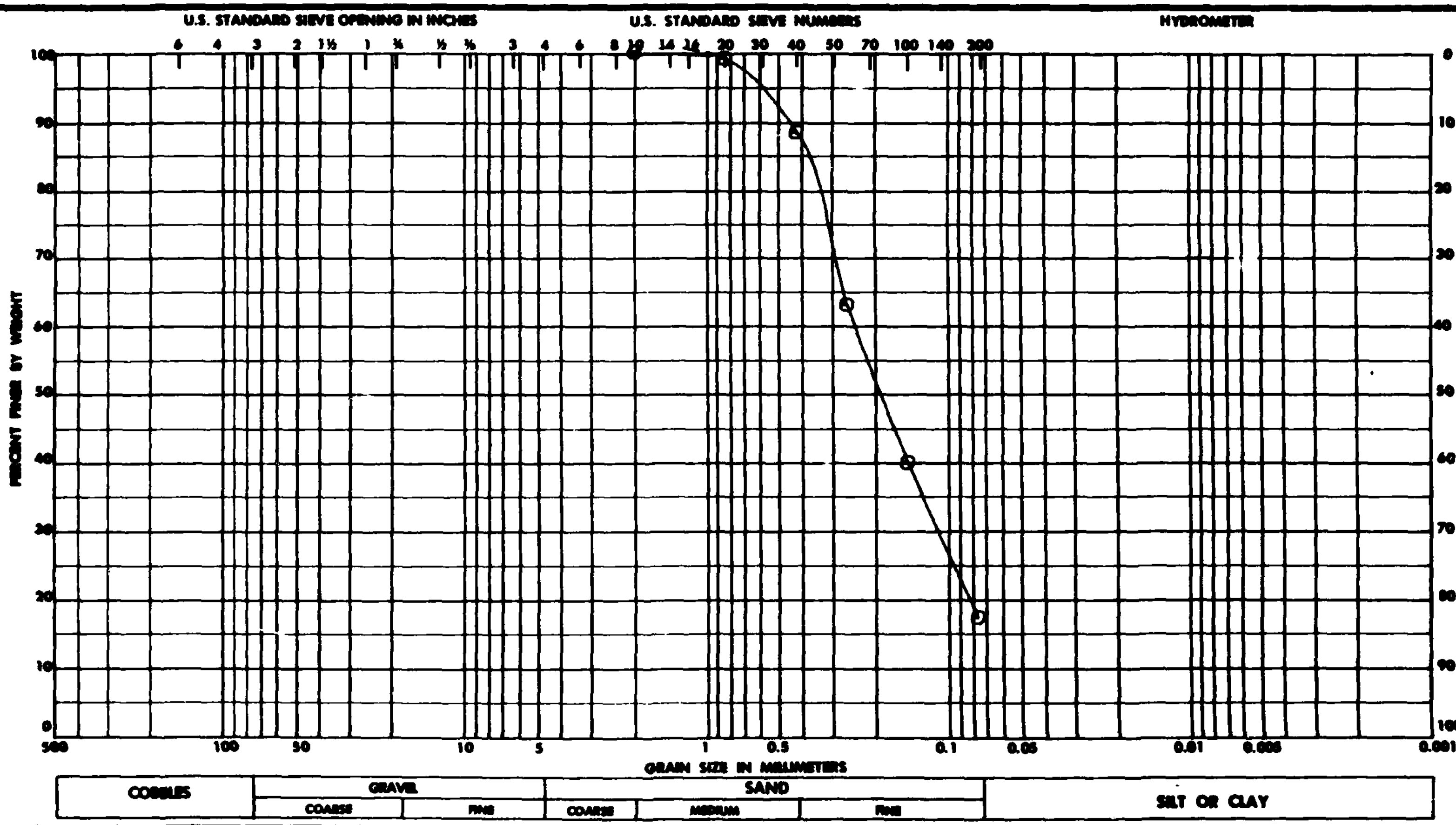
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Depth	Classification	Nat w %	LL	PL	PI
2		VISUAL CLASS. NOT REQUESTED	--	--	--	--
		.				

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3408

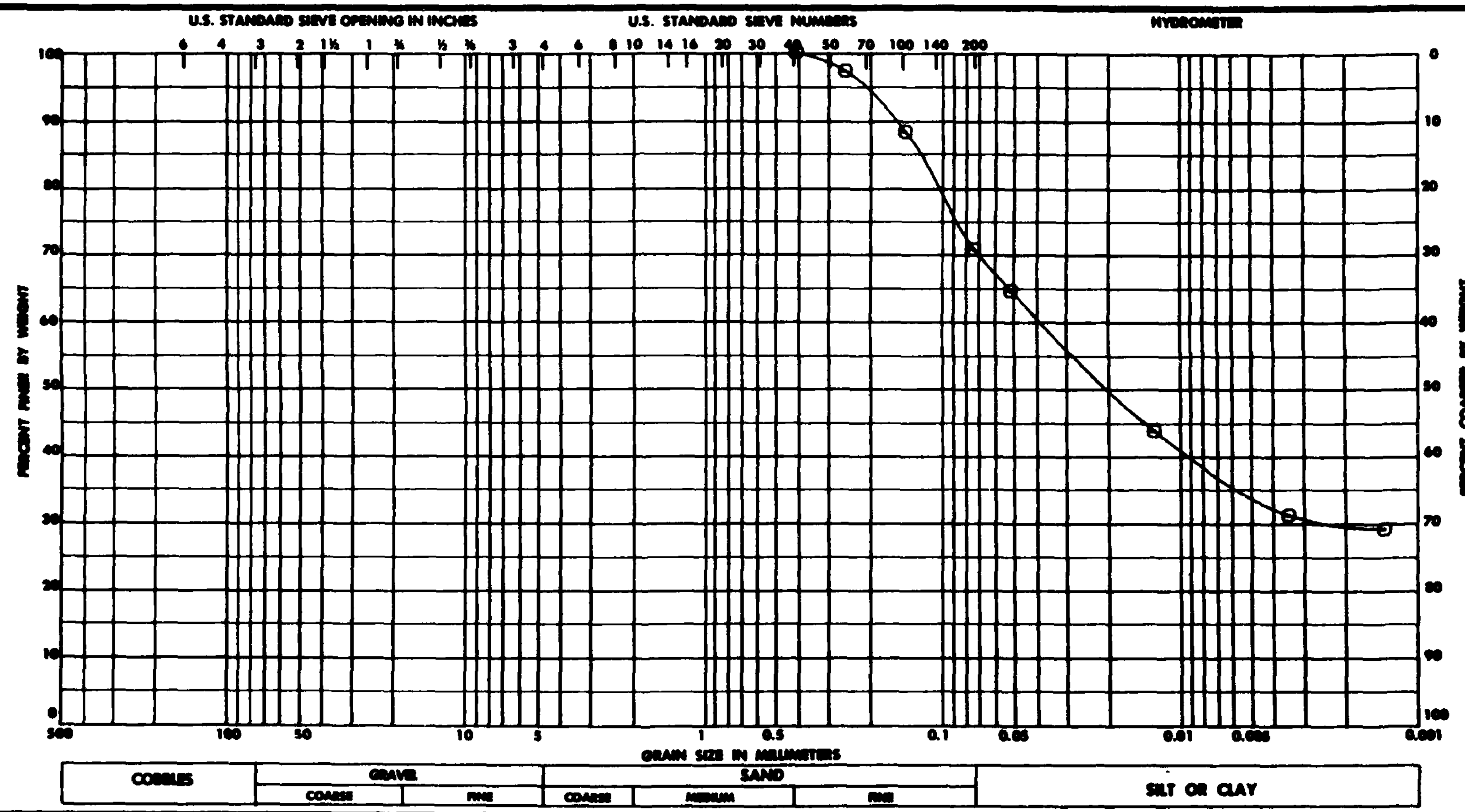
Boring No. VBL-33-87 .SAMPLE 2

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev	Classification	Nat w %	LL	PL	PI
–	13.1 - 16.9	FAT CLAY (CH)	150.0	106	26	80
		GRAY, W/SOME SAND				
		SPECIFIC GRAVITY=2.59				
		L.O.I=8.2				
		UNIT WTD=26.3 PCF				

Project BAYOU LA BATRE
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3411

Boring No. VBL-34-87 .SAMPLE -

Date 10/01/87

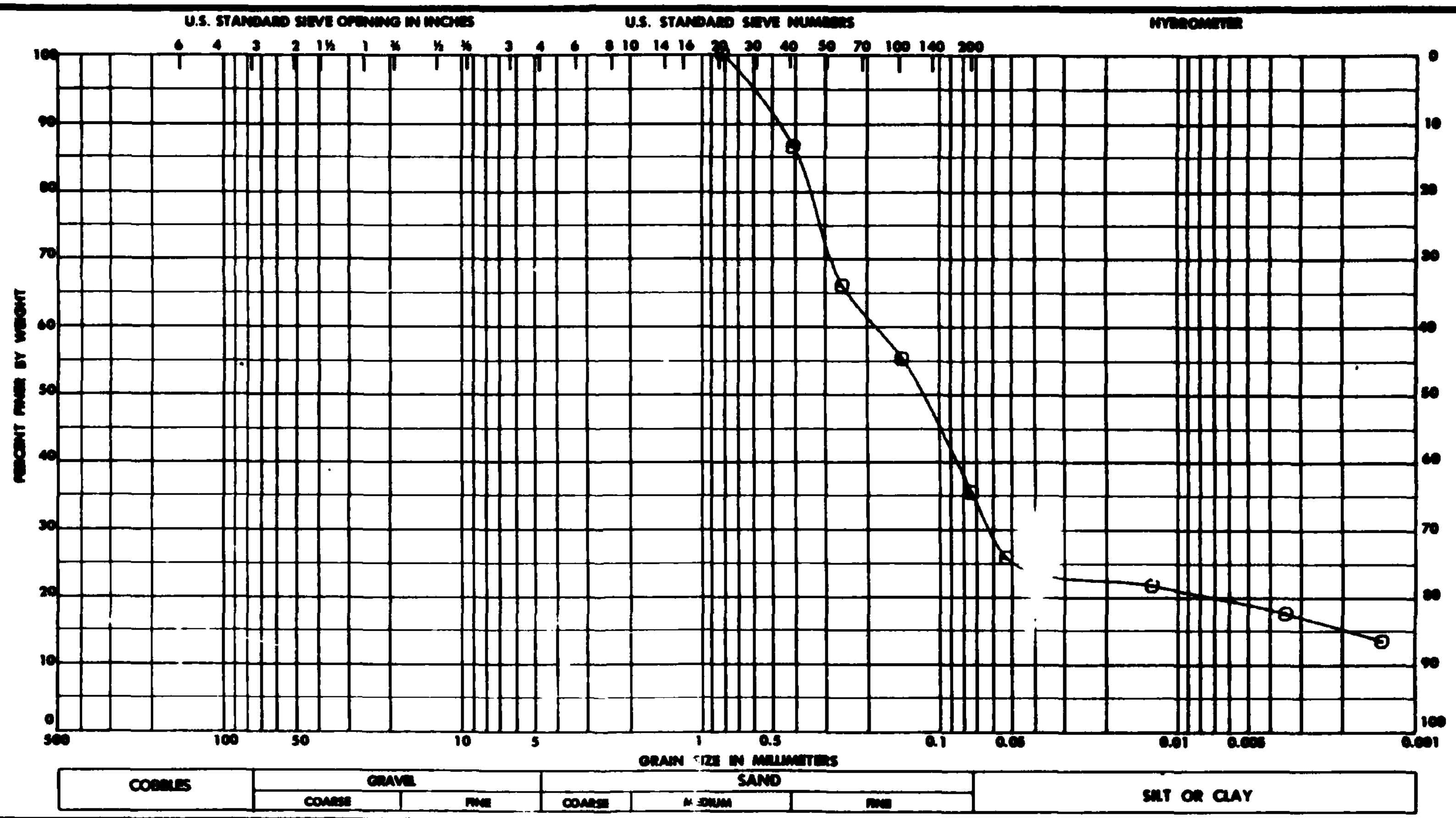
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
--	16.9-19.7	VISUAL SILTY SAND (SM)	[illegible]2.4	NP	NP	NP
		GRAY				
		SPECIFIC GRAVITY=2.64				
		UNIT WT. = 105.0 pcf				

Project BAYOU LA BATRE
CHANNEL & HARBOR DEEPENING

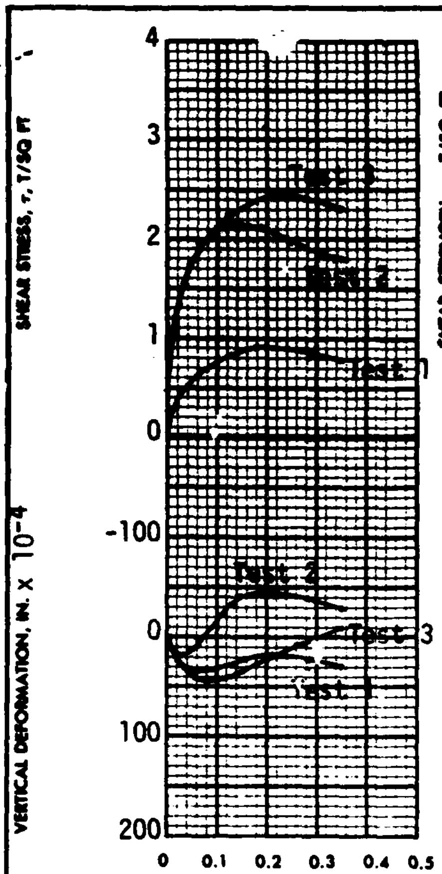
Area LAB NO. 57/3411A

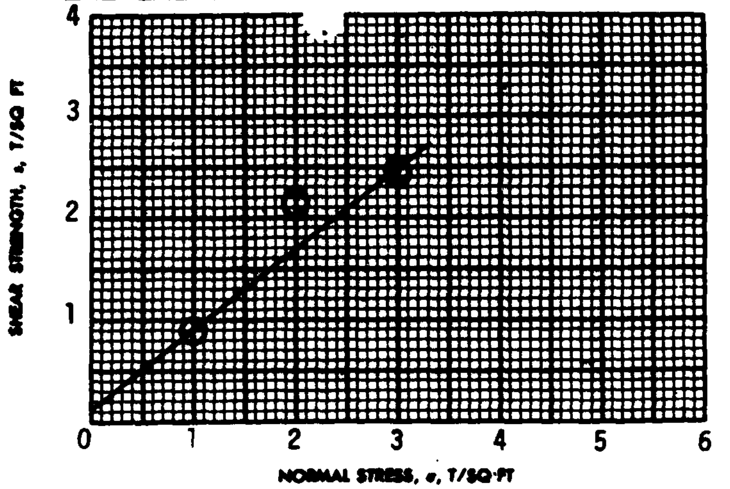
Boring No. VBL-34-87 .SAMPLE -

Date 10/01/87

GRADATION CURVES

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS, MARIETTA, GEORGIA
Work Order No. 5323
Requisition No. 40-87-F & M





TEST NO.			1	2	3	
INITIAL	WATER CONTENT	w_o	20.7 %	19.0 %	22.4 %	%
	VOID RATIO	e_o	.557	.503	.603	
	SATURATION	S_o	98.2 %	100.0 %	98.2 %	%
	DRY DENSITY, LB/CU FT	γ_d	105.8	109.6	102.7	
VOID RATIO AFTER CONSOLIDATION		e_c	.489	.446	.481	
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}	2.0	6.0	6.0	
FINAL	WATER CONTENT	w_f	18.2 %	17.2 %	18.4 %	%
	VOID RATIO	e_f	.480	.455	.485	
	SATURATION	S_f	100.0 %	100.0 %	100.0 %	%
NORMAL STRESS, T/SQ FT		σ	1.00	2.00	3.00	
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}	0.90	2.16	2.45	
ACTUAL TIME TO FAILURE, MIN		t_f	240	180	270	
RATE OF STRAIN, IN./MIN			.0007	.0007	.0007	
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}	.79	1.80	2.32	

SHEAR STRENGTH PARAMETERS

ϕ' = 38.0

TAN ϕ' = 0.781

c' = *0.12 T/SQ FT

*Apparent cohesion not recommended for design computations.

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

TYPE OF SPECIMEN	(Vibracore)	2.0	IN. SQUARE	0.50	IN. THICK
Visual CLASSIFICATION	Gray silty sand (SM)				
LL NP	PL NP	PI NP	--	G_s 2.64	

REMARKS See gradation curve on ENG Form 2087.

PROJECT	MOBILE DISTRICT, Bayou Labatre Channel & Harbor Deepening
AREA	-- Lab No. 57/3411A
BORING NO.	VBL-34-87
SAMPLE NO.	--
XXXXX El	16.9-19.7
DATE	8 October 1987

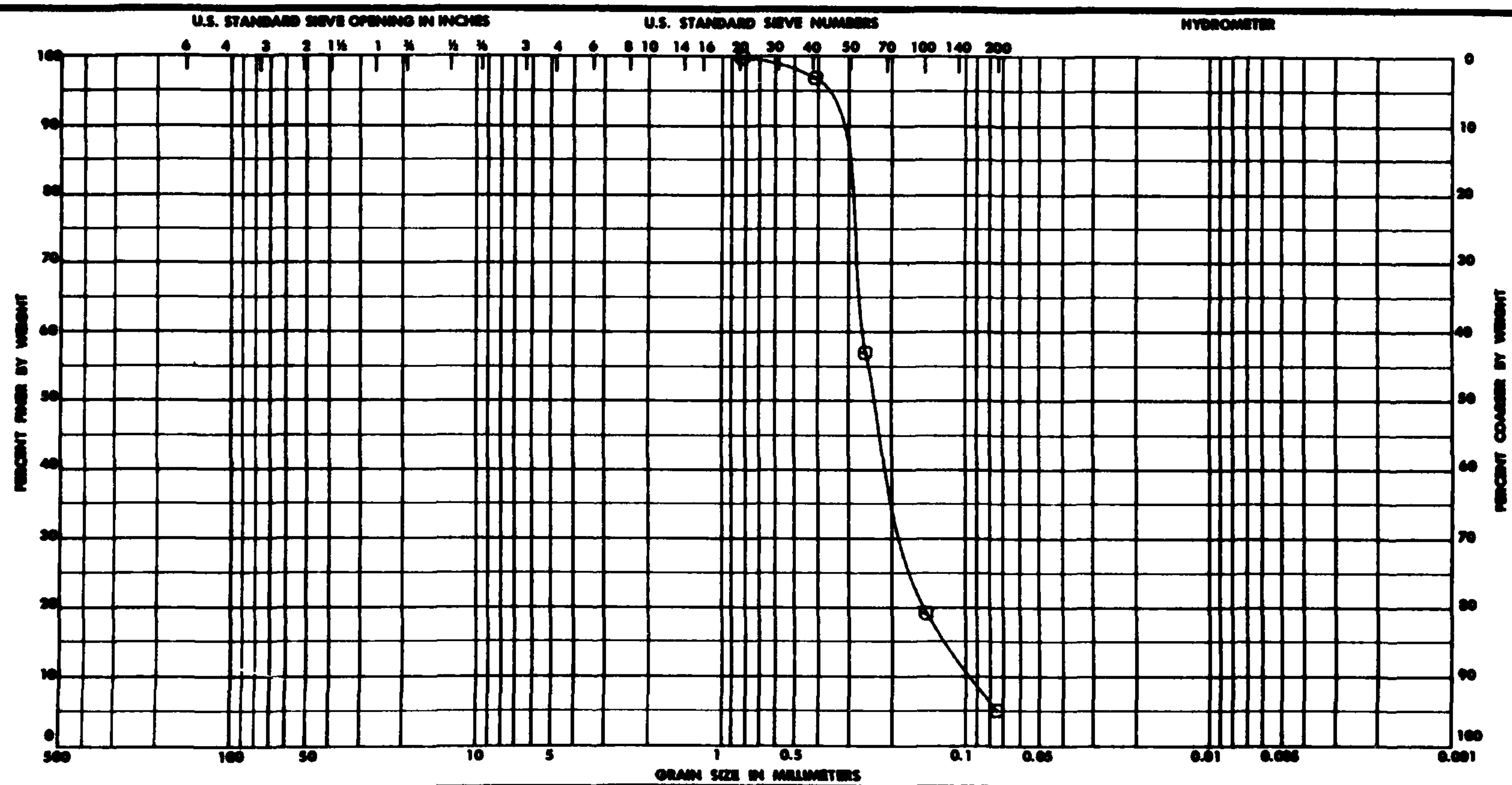
DIRECT SHEAR TEST REPORT

ENG FORM 1 JUN 66 2092 (EM 1110-2-1906) PREVIOUS EDITIONS ARE OBSOLETE (TRANSLUCENT) PLATE IX-3

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Elev	VISUAL Classification	Nat w %	LL	PL	PI
-	19.7-22.7	CLASS. NOT REQUESTED	--	NP	NP	NP

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3411B

Boring No. VBL-34-87 .SAMPLE -

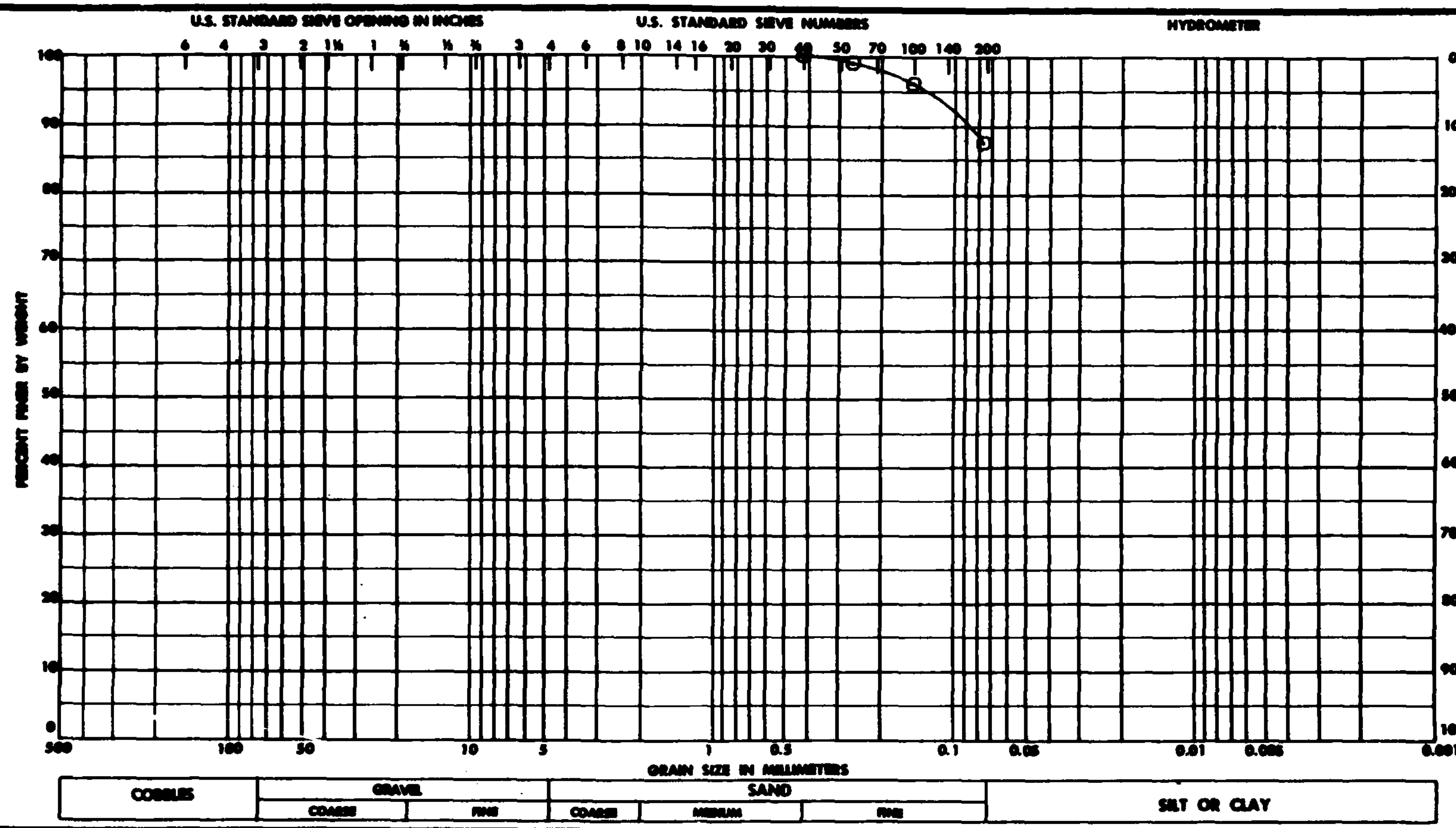
Date 09/28/87

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Depth	Classification	Nat w %	LL	PL	PI
1		VISUAL CLASS. NOT REQUESTED	--	--	--	--

Project	BAYOU LA BATRE CHANNEL CHANNEL & HARBOR DEEPENING
Area	LAB NO. 57/3412
Boring No.	VBL-35-87 .SAMPLE 1
Date	09/23/87

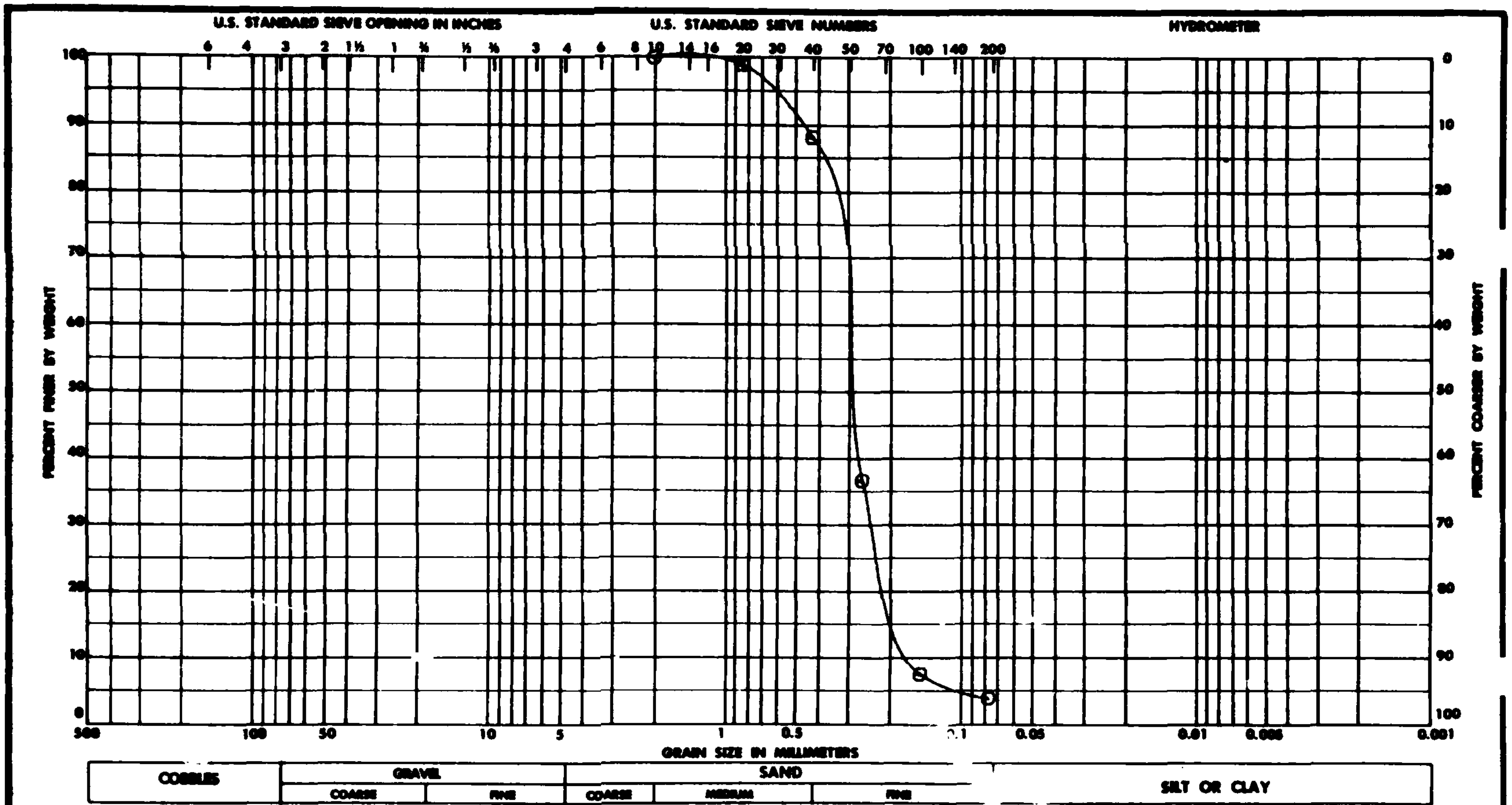
GRADATION CURVES

ENG FORM 1 MAY 63 2087

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-F&M



Sample No.	Depth	VISUAL Classification	Nat w %	LL	PL	PI
3		POORLY GRDED SAND (SP)	--	--	--	--
		GRAY. W/A TRACE OF MICA				

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

Area LAB NO. 57/3414

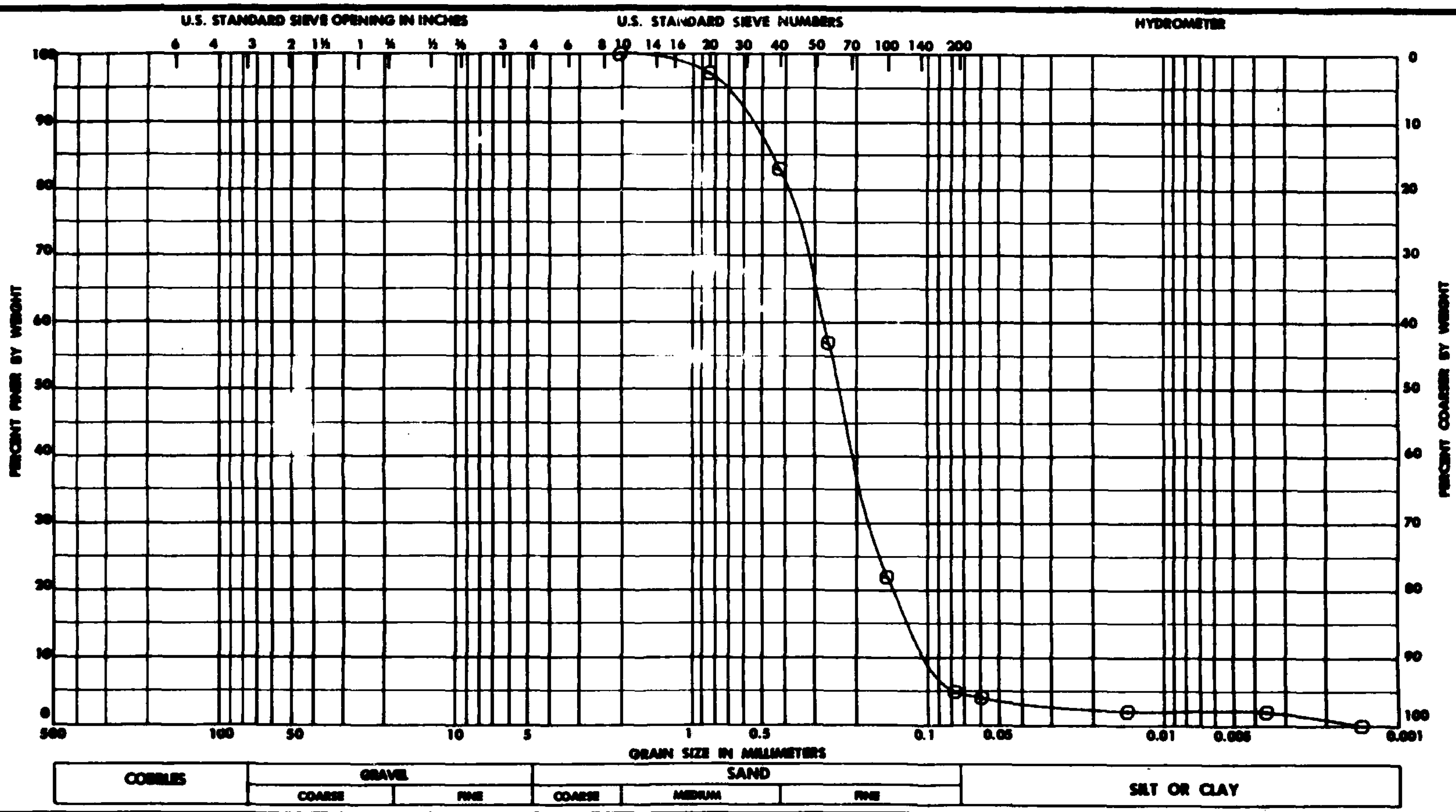
Boring No. VBL-35-87 .SAMPLE 3

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

W.O. No. 5323

Req. No. 40-87-FAM



Sample No.	Depth	VISUAL Classification	Nat w %	LL	PL	PI
4		POORLY GRDED SAND (SP)	20.6	--	--	--
		GRAY. W/A LITTLE MICA				

Project BAYOU LA BATRE CHANNEL
CHANNEL & HARBOR DEEPENING

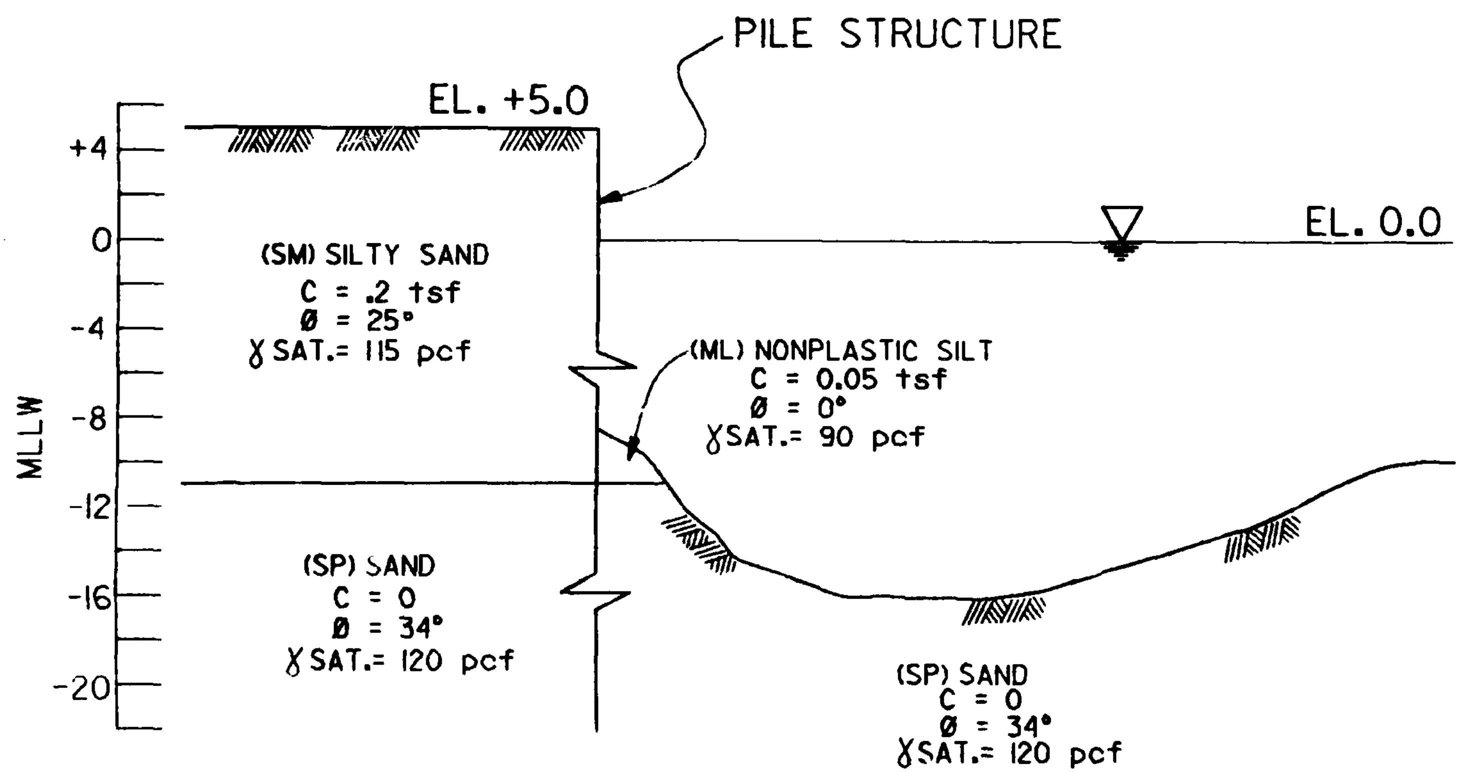
Area LAB NO. 57/3417

Boring No. VBL-36-87 .SAMPLE 4

Date 09/23/87

GRADATION CURVES

ENG FORM 1 MAY 63 2087



BAYOU LA BATRE HARBOR FEASIBILITY REPORT FY-88

TYPICAL SECTION FOR PILE STRUCTURE DESIGN

BAYOU LA BATRE, ALABAMA
UTILITY RELOCATIONS COSTS
WITH-PROJECT CONDITION

Utility	First Cost	IDC *	Total First Cost + IDC	Average Annual Cost
Cast Iron Force Main, 6-inch, above T.B.	$154,300	$20,390	$174,690	$15,300
PVC Force Main, 6-inch, below T.B.	$154,400	$20,400	$174,800	$15,300

* Utility Relocations Costs To Be Incurred During First Year Of Construction.

Note: No Utility Replacement Costs Anticipated Under Without-Project Condition.

BAYOU LA BATRE, ALABAMA
MAINTENANCE DREDGING
INCLUDES BERTHING AREAS Rangename: Avg-Ann-Exist
WITHOUT PROJECT CONDITION Interest Rate: 8.625
3-YEAR CYCLE

A	B	C	D
Channel Segment	Average Cost Per Cycle	Total Present Worth	Average Annual Cost
Dredging Cost.			
Below Turning Basin	$332,500	$1,158,000	$101,500
Turning Basin to Bridge	17,500	61,000	5,300
Site Preparation Cost.			
Below Turning Basin	$90,000	$265,700	$23,300
Turning Basin to Bridge	5,000	14,900	1,300
TOTAL	$445,000	$1,499,600	$131,400

BAYOU LA BATRE
EXISTING BULKHEAD AND PIER REPLACEMENT
FROM MOUTH (130+00) THROUGH TURNING BASIN (30+00)
WITHOUT PROJECT CONDITION
INCLUDES BERTHING AREAS

CHANNEL DEPTH	YEARS 1	5	10	15	25
14 FEET	$1,493,000	$2,274,000	$1,422,000	$2,478,000	$1,493,000
16 FEET	1,493,000	2,274,000	1,422,000	2,478,000	1,493,000
18 FEET	1,493,000	2,274,000	1,422,000	2,478,000	1,493,000
20 FEET	1,493,000	2,274,000	1,422,000	2,478,000	1,493,000
22 FEET	1,493,000	2,274,000	1,422,000	2,478,000	1,493,000

Note: Costs Are For Timber and Sheetpile Bulkhead. Both Have 25-Year Life.

ABOVE TURNING BASIN (30+00) TO HWY.188 BRIDGE (0+00)
WITHOUT PROJECT CONDITION
INCLUDES BERTHING AREAS

CHANNEL DEPTH	YEARS 1	5	10	15	25
14 FEET	$225,600	$269,300	$51,000	$455,950	$225,600

Note: Costs Are For Timber and Sheetpile Bulkhead. Both Have 25-Year Life.
Includes 450' bulkhead at 15 yrs. on right bank immediately below bridge for berthing, r

ABOVE HWY.188 BRIDGE (-15+10)
WITHOUT PROJECT CONDITION
INCLUDES BERTHING AREAS

CHANNEL DEPTH	YEARS 1	5	10	15	25
14 FEET	$117,000	$0	$629,000	$650,000	$117,000

Note: Costs Are For Timber and Sheetpile Bulkhead. Both Have 25-Year Life.

SNAKE BAYOU
WITHOUT PROJECT CONDITION
INCLUDES BERTHING AREAS

CHANNEL DEPTH	YEARS 1	5	10	15	25
14 FEET	$56,000	$0	$246,000	$0	$56,000

Note: Costs Are For Timber and Sheetpile Bulkhead. Both Have 25-Year Life.

YEARS							
0	15	25	30	35	40	50	TOTALS
422,000	$2,478,000	$1,493,000	$2,274,000	$1,422,000	$2,478,000	$1,493,000	$16,827,000
422,000	2,478,000	1,493,000	2,274,000	1,422,000	2,478,000	1,493,000	16,827,000
422,000	2,478,000	1,493,000	2,274,000	1,422,000	2,478,000	1,493,000	16,827,000
422,000	2,478,000	1,493,000	2,274,000	1,422,000	2,478,000	1,493,000	16,827,000
422,000	2,476,000	1,493,000	2,274,000	1,422,000	2,478,000	1,493,000	16,827,000

Both Have 25-Year Life.

YEARS							
0	15	25	30	35	40	50	TOTALS
$51,000	$455,950	$225,600	$269,300	$51,000	$455,950	$225,600	$2,229,300

Both Have 25-Year Life.
nk immediately below bridge for berthing, remainder is from channel side slopes impacts.

YEARS							
0	15	25	30	35	40	50	TOTALS
629,000	$650,000	$117,000	$0	$629,000	$650,000	$117,000	$2,909,000

Both Have 25-Year Life.

YEARS							
0	15	25	30	35	40	50	TOTALS
246,000	$0	$56,000	$0	$246,000	$0	$56,000	$660,000

Both Have 25-Year Life.

2

BAYOU LA BATRE
PRESENT WORTH
EXISTING BULKHEAD AND PIER REPLACEMENTS, WITHOUT PROJECT CONDITION
FROM MOUTH (130+00) THROUGH TURNING BASIN (30+00)
INCLUDES BERTHING AREAS

CHANNEL DEPTH	YEARS 1	5	10	15	25	30
14 FEET	$1,374,500	$1,503,600	$621,700	$716,400	$188,700	$190,100
16 FEET	1,374,500	1,503,600	621,700	$716,400	188,700	190,100
18 FEET	1,374,500	1,503,600	621,700	$716,400	188,700	190,100
20 FEET	1,374,500	1,503,600	621,700	$716,400	188,700	190,100
22 FEET	1,374,500	1,503,600	621,700	$716,400	188,700	190,100

Note: Remaining values at 50 years computed as a percentage of remaining life, i.e. 30 Yr. Cost x 0.20, 35 Y

BAYOU LA BATRE
PRESENT WORTH
EXISTING BULKHEAD AND PIER REPLACEMENTS, WITHOUT PROJECT CONDITION
ABOVE TURNING BASIN (30+00) TO HWY.188 BRIDGE (0+00)
INCLUDES BERTHING AREAS

CHANNEL DEPTH	YEARS 1	5	10	15	25	30
14 FEET	$207,700	$178,100	$22,300	$131,800	$28,500	$22,500

Note: Remaining values at 50 years computed as a percentage of remaining life, i.e. 30 Yr. Cost x 0.20, 35 Y

BAYOU LA BATRE
PRESENT WORTH
EXISTING BULKHEAD AND PIER REPLACEMENTS, WITHOUT PROJECT CONDITION
ABOVE HWY.188 BRIDGE (-15+10)
INCLUDES BERTHING AREAS

CHANNEL DEPTH	YEARS 1	5	10	15	25	30
14 FEET	$107,700	$0	$275,000	$187,900	$14,800	$0

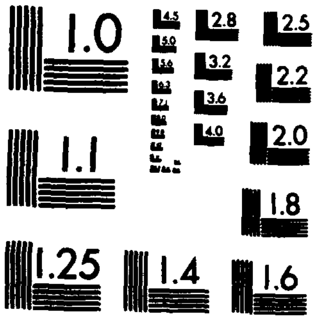
Note: Remaining values at 50 years computed as a percentage of remaining life, i.e. 30 Yr. Cost x 0.20, 35 Y

BAYOU LA BATRE
PRESENT WORTH
EXISTING BULKHEAD AND PIER REPLACEMENTS, WITHOUT PROJECT CONDITION
SNAKE BAYOU
INCLUDES BERTHING AREAS

CHANNEL DEPTH	YEARS 1	5	10	15	25	30
14 FEET	$51,600	$0	$107,600	$0	$7,100	$0

Note: Remaining values at 50 years computed as a percentage of remaining life, i.e. 30 Yr. Cost x 0.20, 35

AD-A201 866 FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT 6/6
FOR NAVIGATION IMPR..(U) CORPS OF ENGINEERS SOUTH
ATLANTIC MOBILE AL COASTAL SECTION.. J K GRAHAM ET AL.
UNCLASSIFIED 12 SEP 88 COESAM/PDFC-88/05 F/G 13/2 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

	40	PRESENT WORTH REMAINING VALUE 30-YEAR COST AT 50 YEARS	PRESENT WORTH REMAINING VALUE 35-YEAR COST AT 50 YEARS	PRESENT WORTH REMAINING VALUE 40-YEAR COST AT 50 YEARS	NET PRESENT WORTH 30-YEAR COST	NET PRESENT WORTH 35-YEAR COST	NET PRESENT WORTH 40-YEAR COST	TOTAL NET PRESENT WORTH
0	$90,600	$7,300	$9,100	$23,800	$182,800	$69,500	$66,800	$4,724,000
0	90,600	7,300	9,100	23,800	182,800	69,500	66,800	4,724,000
0	90,600	7,300	9,100	23,800	182,800	69,500	66,800	4,724,000
0	90,600	7,300	9,100	23,800	182,800	69,500	66,800	4,724,000
0	90,600	7,300	9,100	23,800	182,800	69,500	66,800	4,724,000

0.40, 40 Yr. Cost x 0.60.

	40	PRESENT WORTH REMAINING VALUE 30-YEAR COST AT 50 YEARS	PRESENT WORTH REMAINING VALUE 35-YEAR COST AT 50 YEARS	PRESENT WORTH REMAINING VALUE 40-YEAR COST AT 50 YEARS	NET PRESENT WORTH 30-YEAR COST	NET PRESENT WORTH 35-YEAR COST	NET PRESENT WORTH 40-YEAR COST	TOTAL NET PRESENT WORTH
0	$16,700	$900	$300	$4,400	$21,600	$2,500	$12,300	$604,800

0.40, 40 Yr. Cost x 0.60.

	40	PRESENT WORTH REMAINING VALUE 30-YEAR COST AT 50 YEARS	PRESENT WORTH REMAINING VALUE 35-YEAR COST AT 50 YEARS	PRESENT WORTH REMAINING VALUE 40-YEAR COST AT 50 YEARS	NET PRESENT WORTH 30-YEAR COST	NET PRESENT WORTH 35-YEAR COST	NET PRESENT WORTH 40-YEAR COST	TOTAL NET PRESENT WORTH
00	$23,800	$0	$4,000	$6,200	$0	$30,800	$17,600	$633,800

0.40, 40 Yr. Cost x 0.60.

	40	PRESENT WORTH REMAINING VALUE 30-YEAR COST AT 50 YEARS	PRESENT WORTH REMAINING VALUE 35-YEAR COST AT 50 YEARS	PRESENT WORTH REMAINING VALUE 40-YEAR COST AT 50 YEARS	NET PRESENT WORTH 30-YEAR COST	NET PRESENT WORTH 35-YEAR COST	NET PRESENT WORTH 40-YEAR COST	TOTAL NET PRESENT WORTH
500	$0	$0	$1,600	$0	$0	$12,000	$0	$178,300

x 0.40, 40 Yr. Cost x 0.60.

2

BAYOU LA BATRE
AVERAGE ANNUAL COST (NET PRESENT WORTH ANNUALIZED)
EXISTING BULKHEAD AND PIER REPLACEMENT, WITHOUT PROJECT CONDITION
INCLUDES BERTHING AREAS

CHANNEL DEPTH	CHANNEL SEGMENT: MOUTH THROUGH TURNING BASIN	TURNING BASIN TO BRIDGE	ABOVE HWY.188 BRIDGE	SNAKE BAYOU
14 FEET	$414,100	$53,000	$55,600	$15,600
16 FEET	414,100	N/A	N/A	N/A
18 FEET	414,100	N/A	N/A	N/A
20 FEET	414,100	N/A	N/A	N/A
22 FEET	414,100	N/A	N/A	N/A

BAYOU LA BATRE
FIRST COST
BULKHEAD AND PIER REPLACEMENT
WITH PROJECT
INCLUDES BERTHING AREAS

CHANNEL DEPTH	CHANNEL SEGMENTS: MOUTH THRU TURNING BASIN		TURNING BASIN TO BRIDGE		ABOVE HWY.188 BRIDGE		
	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFF ON
14 FEET	$12,527,000	$13,236,000	$1,374,000	$1,882,000	$2,057,000	$2,389,000	
16 FEET	14,422,000	15,804,000	N/A	N/A	N/A	N/A	
18 FEET	15,050,000	16,489,000	N/A	N/A	N/A	N/A	
20 FEET	15,117,000	17,389,000	N/A	N/A	N/A	N/A	
22 FEET	15,699,000	18,474,000	N/A	N/A	N/A	N/A	

Note: All Costs Contain Bend Widening and 20% Contingencies.
* Affected Only Means Only Those Existing Affected Bulkheads To Be Replaced Due To Deepening.
** This Means The Affected Existing Bulkheads Plus Additional Bulkheads To Protect Property.

BAYOU LA BATRE
INTEREST DURING CONSTRUCTION
BULKHEAD AND PIER REPLACEMENT
WITH PROJECT
INCLUDES BERTHING AREAS

CHANNEL DEPTH	CHANNEL SEGMENTS: MOUTH THRU TURNING BASIN		TURNING BASIN TO BRIDGE		ABOVE HWY.188 BRIDGE		
	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AF (
14 FEET	$1,655,140	$1,748,820	$181,540	$248,660	$271,780	$315,650	
16 FEET	1,905,520	2,088,120	N/A	N/A	N/A	N/A	
18 FEET	1,988,490	2,178,620	N/A	N/A	N/A	N/A	
20 FEET	1,997,350	2,297,540	N/A	N/A	N/A	N/A	
22 FEET	2,074,240	2,440,890	N/A	N/A	N/A	N/A	

Note: All Costs To Be Incurred During First Year Of Construction.
* Affected Only Means Only Those Existing Affected Bulkheads To Be Replaced Due To Deepening.
** This Means The Affected Existing Bulkheads Plus Additional Bulkheads To Protect Property.

SNAKE BAYOU
$15,600
N/A
N/A
N/A
N/A

CHANNEL SEGMENTS

TO BRIDGE	ABOVE HWY.188 BRIDGE		SNAKE BAYOU			
AFFECTED AND PROPERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **	TOTAL AFFECT. & PROP.	TOTAL AFFECT. ONLY
$1,882,000	$2,057,000	$2,389,000	$367,000	$367,000	$17,874,000	$16,325,000
N/A	N/A	N/A	N/A	N/A	20,442,000	18,220,000
N/A	N/A	N/A	N/A	N/A	21,127,000	18,848,000
N/A	N/A	N/A	N/A	N/A	22,027,000	18,915,000
N/A	N/A	N/A	N/A	N/A	23,112,000	19,497,000

To Be Replaced Due To Deepening.
Bulkheads To Protect Property.

CHANNEL SEGMENTS

TO BRIDGE	ABOVE HWY.188 BRIDGE		SNAKE BAYOU	
AFFECTED AND PROPERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **
$248,660	$271,780	$315,650	$48,490	$48,490
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A

ion.
To Be Replaced Due To Deepening.
Bulkheads To Protect Property.

BAYOU LA BATRE
FIRST COST AND IDC
BULKHEAD AND PIER REPLACEMENT
WITH PROJECT
INCLUDES BERTHING AREAS

CHANNEL SEGMENTS

CHANNEL DEPTH	MOUTH THRU TURNING BASIN		TURNING BASIN TO BRIDGE		ABOVE HWY.188 BRIDGE		SNAKE BA
	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFFECTED ONLY *
14 FEET	$14,182,140	$14,984,820	$1,555,540	$2,130,660	$2,328,780	$2,704,650	$415,490
16 FEET	16,327,520	17,892,120	N/A	N/A	N/A	N/A	N/A
18 FEET	17,038,490	18,667,620	N/A	N/A	N/A	N/A	N/A
20 FEET	17,114,350	19,686,540	N/A	N/A	N/A	N/A	N/A
22 FEET	17,773,240	20,914,890	N/A	N/A	N/A	N/A	N/A

Note: All Costs To Be Incurred During First Year Of Construction.
* Affected Only Means Only Those Existing Affected Bulkheads To Be Replaced Due To Deepening.
** This Means The Affected Existing Bulkheads Plus Additional Bulkheads To Protect Property.

BAYOU LA BATRE
AVERAGE ANNUAL COST
BULKHEAD AND PIER REPLACEMENT
WITH PROJECT
INCLUDES BERTHING AREAS
8.625

AVERAGE ANNUAL COST
FIRST COST, CONSTRUCTION - ANNUALIZED BULKHEAD REPLACEMENT COST, WITHOUT PROJECT

CHANNEL SEGMENTS

CHANNEL DEPTH	MOUTH THRU TURNING BASIN		TURNING BASIN TO BRIDGE		ABOVE HWY.188 BRIDGE		SNAKE BA
	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFFECTED ONLY *
14 FEET	$829,000	$899,300	$83,300	$133,800	$148,500	$181,500	$20,800
16 FEET	1,017,000	1,154,200	N/A	N/A	N/A	N/A	N/A
18 FEET	1,079,300	1,222,100	N/A	N/A	N/A	N/A	N/A
20 FEET	1,086,000	1,311,400	N/A	N/A	N/A	N/A	N/A
22 FEET	1,143,700	1,419,100	N/A	N/A	N/A	N/A	N/A

Note: Values In This Table Are Net Average Annual Bulkhead Replacement Costs.
* Affected Only Means Only Those Existing Affected Bulkheads To Be Replaced Due To Deepening.
** This Means The Affected Existing Bulkheads Plus Additional Bulkheads To Protect Property.

CHANNEL SEGMENTS

; BASIN	TURNING BASIN TO BRIDGE		ABOVE HWY.188 BRIDGE		SNAKE BAYOU	
:CTED AND)PERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **
14,984,820	$1,555,540	$2,130,660	$2,328,780	$2,704,650	$415,490	$415,490
17,892,120	N/A	N/A	N/A	N/A	N/A	N/A
18,667,620	N/A	N/A	N/A	N/A	N/A	N/A
19,686,540	N/A	N/A	N/A	N/A	N/A	N/A
20,914,890	N/A	N/A	N/A	N/A	N/A	N/A

-ing First Year Of Construction.
:xisting Affected Bulkheads To Be Replaced Due To Deepening.
, Bulkheads Plus Additional Bulkheads To Protect Property.

AVERAGE ANNUAL COST
IRST COST, CONSTRUCTION - ANNUALIZED BULKHEAD REPLACEMENT COST, WITHOUT PROJECT

CHANNEL SEGMENTS

G BASIN	TURNING BASIN TO BRIDGE		ABOVE HWY.188 BRIDGE		SNAKE BAYOU		
ECTED AND)PERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **	AFFECTED ONLY *	AFFECTED AND PROPERTY **	TOTALS AFTD. & PROP.
$899,300	$83,300	$133,800	$148,500	$181,500	$20,800	$20,800	$1,235,400
1,154,200	N/A	N/A	N/A	N/A	N/A	N/A	1,490,300
1,222,100	N/A	N/A	N/A	N/A	N/A	N/A	1,558,200
1,311,400	N/A	N/A	N/A	N/A	N/A	N/A	1,647,500
1,419,100	N/A	N/A	N/A	N/A	N/A	N/A	1,755,200

t Average Annual Bulkhead Replacement Costs.
Existing Affected Bulkheads To Be Replaced Due To Deepening.
g Bulkheads Plus Additional Bulkheads To Protect Property.

1

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BAYOU LA BATRE
DREDGING COST, AVERAGE ANNUAL
CONSTRUCTION DREDGING
INCLUDES BERTHING AREAS
5/31/88
BAYOU CHANNEL: TURNING BASIN (30+00) TO MOUTH (130+00) Rangename: Mouth-TB
Disposal Method: Upland, New and Existing ("Charlie") Disposal Areas

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	TOTAL FIRST CO W/ MOB-DE (D+E+F+I
14+1+1	118,300	$2.13	$251,979	$70,900	$82,575	17	$3,600	$62,460	$142,048	$609,
16+1+1	287,500	1.04	299,000	70,900	95,152	51	3,600	184,176	211,272	860,
18+1+1	423,700	0.88	372,856	70,900	107,727	61	3,600	219,132	262,138	1,032,
20+1+1	594,400	0.79	469,576	70,900	120,304	86	3,600	309,708	263,463	1,233,
22+1+1	783,300	0.77	603,141	70,900	132,879	114	3,600	411,732	256,012	1,474,

* No Dredging First Year in Bayou Channel; Costs are Lands, Diking and Site Prep.

BAYOU CHANNEL: TURNING BASIN (30+00) TO STA. 90+45 Rangename: Half-Up
Disposal Method: Upland, New Disposal Area

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	TOTAL FIRST CO W/ MOB-DE (D+E+F+I
14+1+1	58,300	$1.97	$114,851	$35,450	n/a	17	$3,600	$62,460	$142,048	$354,
16+1+1	179,800	0.85	152,830	35,450	n/a	51	3,600	184,176	211,272	583,
18+1+1	252,200	0.78	196,716	35,450	n/a	61	3,600	219,132	262,138	713,
20+1+1	363,800	0.76	276,488	35,450	n/a	86	3,600	309,708	263,463	885,
22+1+1	487,400	0.70	341,180	35,450	n/a	114	3,600	411,732	256,012	1,044,

* No Dredging First Year in Bayou Channel; Costs are Lands, Diking and Site Prep.

BAYOU CHANNEL: STA. 90+45 TO MOUTH (130+00) Rangename: Half-Down
Disposal Method: Upland, Existing Disposal Area "Charlie"

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	TOTAL FIRST CO W/ MOB-DE (D+E+F+I
14+1+1	60,000	$2.28	$136,800	$35,450	$82,575	n/a	$3,600	$0	n/a	$254,
16+1+1	107,700	1.36	146,472	35,450	95,152	n/a	3,600	0	n/a	277,
18+1+1	171,500	1.02	174,930	35,450	107,727	n/a	3,600	0	n/a	318,
20+1+1	230,600	0.84	193,704	35,450	120,304	n/a	3,600	0	n/a	349,
22+1+1	295,900	0.89	263,351	35,450	132,879	n/a	3,600	0	n/a	431,

* No Dredging First Year in Bayou Channel; Costs are Lands, Diking and Site Prep.

BAYOU CHANNEL: BRIDGE (0+00) TO MOUTH (130+00) Rangename: Bridge-Mouth
Disposal Method: Upland, New and Existing ("Charlie") Disposal Areas

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	TOTAL FIRST CO W/ MOB-DE (D+E+F+I
14+1+1	158,400	$1.91	$302,544	$70,900	$82,575	29	$3,600	$105,048	$181,640	$742,
16+1+1	327,600	1.07	350,532	70,900	95,152	63	3,600	225,972	232,463	975,
18+1+1	463,800	0.91	422,058	70,900	107,727	73	3,600	262,260	282,316	1,145,
20+1+1	634,500	0.82	520,290	70,900	120,304	98	3,600	353,808	280,979	1,346,
22+1+1	823,400	0.80	658,720	70,900	132,879	127	3,600	456,840	269,334	1,588,

* No Dredging First Year in Bayou Channel; Costs are Lands, Diking and Site Prep.

	K	L	M	N	O	P	Q	R	S	T
	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (F+I+J) *	First Year Cost W/O Mob-Demob (F+I+J) *	Second Year Cost W/ Mob-Demob (D+E)	Second Year Cost W/O Mob-Demob (D)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Yea Cost W/O Mob-Dem
8	$609,962	$539,062	$287,083	$287,083	$322,879	$251,979	$37,930	$37,930	$13,640	$10,64
2	860,500	789,600	490,600	490,600	369,900	299,000	64,820	64,820	15,620	12,63
6	1,032,753	961,853	588,997	588,997	443,756	372,856	77,820	77,820	18,740	15,75
3	1,233,951	1,163,051	693,475	693,475	540,476	469,576	91,630	91,630	22,830	19,83
2	1,474,664	1,403,764	800,623	800,623	674,041	603,141	105,780	105,780	28,470	25,47

	K	L	M	N	O	P	Q	R	S	T
	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (F+I+J) *	First Year Cost W/O Mob-Demob (F+I+J) *	Second Year Cost W/ Mob-Demob (D+E)	Second Year Cost W/O Mob-Demob (D)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Yea Cost W/O Mob-Dem
18	$354,809	$319,359	$204,508	$204,508	$150,301	$114,851	$27,020	$27,020	$6,350	$4,85
72	583,728	548,278	395,448	395,448	188,280	152,830	52,250	52,250	7,950	6,45
38	713,436	677,986	481,270	481,270	232,166	196,716	63,590	63,590	9,810	8,31
53	885,109	849,659	573,171	573,171	311,938	276,488	75,730	75,730	13,170	11,68
12	1,044,374	1,008,924	667,744	667,744	376,630	341,180	88,230	88,230	15,910	14,41

	K	L	M	N	O	P	Q	R	S	T
	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (F+I+J) *	First Year Cost W/O Mob-Demob (F+I+J) *	Second Year Cost W/ Mob-Demob (D+E)	Second Year Cost W/O Mob-Demob (D)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Ye Cost W/O Mob-De
	$254,825	$219,375	$82,575	$82,575	$172,250	$136,800	$10,910	$10,910	$7,270	$5,7
	277,074	241,624	95,152	95,152	181,922	146,472	12,570	12,570	7,680	6,1
	318,107	282,657	107,727	107,727	210,380	174,930	14,230	14,230	8,890	7,3
	349,458	314,008	120,304	120,304	229,154	193,704	15,900	15,900	9,680	8,1
	431,680	396,230	132,879	132,879	298,801	263,351	17,560	17,560	12,620	11,1

	K	L	M	N	O	P	Q	R	S	T
	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (F+I+J) *	First Year Cost W/O Mob-Demob (F+I+J) *	Second Year Cost W/ Mob-Demob (D+E)	Second Year Cost W/O Mob-Demob (D)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Y Cost W/O Mob-D
10	$742,707	$671,807	$369,263	$369,263	$373,444	$302,544	$48,790	$48,790	$15,770	$12,
53	975,019	904,119	553,587	553,587	421,432	350,532	73,140	73,140	17,800	14,
16	1,145,261	1,074,361	652,303	652,303	492,958	422,058	86,190	86,190	20,820	17,
79	1,346,281	1,275,381	755,091	755,091	591,190	520,290	99,770	99,770	24,970	21,
14	1,588,673	1,517,773	859,053	859,053	729,620	658,720	113,500	113,500	30,810	27,

1 2

	Q	R	S	T	U	V	W	X
ear ... emob	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
979	$37,930	$37,930	$13,640	$10,640	$661,532	$587,632	$57,980	$51,510
000	64,820	64,820	15,620	12,630	940,940	867,050	82,470	76,000
856	77,820	77,820	18,740	15,750	1,129,313	1,055,423	98,980	92,510
576	91,630	91,630	22,830	19,830	1,348,411	1,274,511	118,190	111,710
141	105,780	105,780	28,470	25,470	1,608,914	1,535,014	141,020	134,540

	Q	R	S	T	U	V	W	X
'ear ...)emob	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
,851	$27,020	$27,020	$6,350	$4,850	$388,179	$351,229	$34,020	$30,790
,830	52,250	52,250	7,950	6,450	643,928	606,978	56,440	53,200
,716	63,590	63,590	9,810	8,310	786,836	749,886	68,970	65,730
,488	75,730	75,730	13,170	11,680	974,009	937,069	85,370	82,130
,180	88,230	88,230	15,910	14,410	1,148,514	1,111,564	100,670	97,430

	Q	R	S	T	U	V	W	X
'ear ...)emob	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
,800	$10,910	$10,910	$7,270	$5,780	$273,005	$236,065	$23,930	$20,690
,472	12,570	12,570	7,680	6,190	297,324	260,384	26,060	22,820
,930	14,230	14,230	8,890	7,390	341,227	304,277	29,910	26,670
,704	15,900	15,900	9,680	8,180	375,038	338,088	32,870	29,630
,351	17,560	17,560	12,620	11,120	461,860	424,910	40,480	37,240

	Q	R	S	T	U	V	W	X
'ear ...)emob	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
,544	$48,790	$48,790	$15,770	$12,780	$807,267	$733,377	$70,760	$64,280
,532	73,140	73,140	17,800	14,800	1,065,959	992,059	93,430	86,950
,058	86,190	86,190	20,820	17,820	1,252,271	1,178,371	109,760	103,280
,290	99,770	99,770	24,970	21,970	1,471,021	1,397,121	128,940	122,460
,720	113,500	113,500	30,810	27,820	1,732,983	1,659,093	151,900	145,420

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#2

BAYOU CHANNEL: BRIDGE (0+00) TO TURNING BASIN (30+00) Rangename: Bridge-TB

Disposal Method: Upland, New Disposal Area

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)
14+1+1	40,100	$1.25	$50,125	n/a	n/a	12	$3,600	$42,588	$39,592	$132,305
16+1+1	40,100	1.25	50,125	n/a	n/a	12	3,600	41,796	21,191	113,112
18+1+1	40,100	1.25	50,125	n/a	n/a	12	3,600	43,128	20,178	113,431
20+1+1	40,100	1.25	50,125	n/a	n/a	12	3,600	44,100	17,516	111,741
22+1+1	40,100	1.25	50,125	n/a	n/a	13	3,600	45,108	13,322	108,555

* No Dredging First Year in Bayou Channel; Costs are Lands, Diking and Site Prep.

BAYOU CHANNEL: ABOVE BRIDGE (-15+55) TO MOUTH (130+00) Rangename: Above-Mouth

Disposal Method: Upland, New and Existing ("Charlie") Disposal Areas

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)
14+1+1	230,100	$2.08	$478,608	$70,900	$82,575	53	$3,600	$190,080	$220,401	$1,042,564
16+1+1	399,300	1.31	523,083	70,900	95,152	86	3,600	311,004	269,812	1,269,951
18+1+1	535,500	1.12	599,760	70,900	107,727	96	3,600	347,292	317,721	1,443,400
20+1+1	706,200	0.98	692,076	70,900	120,304	122	3,600	438,840	311,921	1,634,041
22+1+1	895,100	0.92	823,492	70,900	132,879	151	3,600	541,872	292,777	1,861,920

* No Dredging First Year in Bayou Channel; Costs are Lands, Diking and Site Prep.

BAYOU CHANNEL: BRIDGE (0+00) TO ABOVE BRIDGE (-15+55) Rangename: Above-Bridge

Disposal Method: Upland, New Disposal Area

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)
14+1+1	71,700	$2.51	$179,967	n/a	n/a	24	$3,600	$85,032	$38,761	$303,760
16+1+1	71,700	2.51	179,967	n/a	n/a	24	3,600	85,032	37,349	302,348
18+1+1	71,700	2.51	179,967	n/a	n/a	24	3,600	85,032	35,405	300,404
20+1+1	71,700	2.51	179,967	n/a	n/a	24	3,600	85,032	30,942	295,941
22+1+1	71,700	2.51	179,967	n/a	n/a	24	3,600	85,032	23,443	288,442

* No Dredging First Year in Bayou Channel; Costs are Lands, Diking and Site Prep.

BAYOU CHANNEL: ALL BAYOU, ABOVE BRIDGE (-15+55) TO MOUTH (130+00) AND SNAKE BAYOU Rangename: All-Bayou

Disposal Method: Upland, New and Existing ("Charlie") Disposal Areas

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)
14+1+1	261,900	$2.14	$560,466	$70,900	$82,575	63	$3,600	$226,224	$240,819	$1,180,984
16+1+1	431,100	1.40	603,540	70,900	95,152	96	3,600	347,148	288,259	1,404,999
18+1+1	567,300	1.20	680,760	70,900	107,727	107	3,600	383,436	334,750	1,577,573
20+1+1	738,000	1.05	774,900	70,900	120,304	132	3,600	474,984	326,374	1,767,462
22+1+1	926,900	0.98	908,362	70,900	132,879	161	3,600	578,016	303,506	1,993,663

* No Dredging First Year in Bayou Channel; Costs are Lands, Diking and Site Prep.

	K	L	M	N	O	P	Q	R	S	T
D/A ng or ep st	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (F+I+J) *	First Year Cost W/O Mob-Demob (F+I+J) *	Second Year Cost W/ Mob-Demob (D+E)	Second Year Cost W/O Mob-Demob (D)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Cost W/O Mob-
9,592	$132,305	$132,305	$82,180	$82,180	$50,125	$50,125	$10,860	$10,860	$2,120	$2
1,191	113,112	113,112	62,987	62,987	50,125	50,125	8,320	8,320	2,120	2
0,178	113,431	113,431	63,306	63,306	50,125	50,125	8,360	8,360	2,120	2
7,516	111,741	111,741	61,616	61,616	50,125	50,125	8,140	8,140	2,120	2
3,322	108,555	108,555	58,430	58,430	50,125	50,125	7,720	7,720	2,120	2

	K	L	M	N	O	P	Q	R	S	T
D/A ng or ep st	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (F+I+J) *	First Year Cost W/O Mob-Demob (F+I+J) *	Second Year Cost W/ Mob-Demob (D+E)	Second Year Cost W/O Mob-Demob (D)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Cost W/O Mob-
0,401	$1,042,564	$971,664	$493,056	$493,056	$549,508	$478,608	$65,150	$65,150	$23,210	$20
9,812	1,269,951	1,199,051	675,968	675,968	593,983	523,083	89,310	89,310	25,090	22
7,721	1,443,400	1,372,500	772,740	772,740	670,660	599,760	102,100	102,100	28,320	25
1,921	1,634,041	1,563,141	871,065	871,065	762,976	692,076	115,090	115,090	32,220	29
2,777	1,861,920	1,791,020	967,528	967,528	894,392	823,492	127,840	127,840	37,770	34

	K	L	M	N	O	P	Q	R	S	T
D/A ng or ep st	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (F+I+J) *	First Year Cost W/O Mob-Demob (F+I+J) *	Second Year Cost W/ Mob-Demob (D+E)	Second Year Cost W/O Mob-Demob (D)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Cos W/O Mob
8,761	$303,760	$303,760	$123,793	$123,793	$179,967	$179,967	$16,360	$16,360	$7,600	$
7,349	302,348	302,348	122,381	122,381	179,967	179,967	16,170	16,170	7,600	
5,405	300,404	300,404	120,437	120,437	179,967	179,967	15,910	15,910	7,600	
0,942	295,941	295,941	115,974	115,974	179,967	179,967	15,320	15,320	7,600	
3,443	288,442	288,442	108,475	108,475	179,967	179,967	14,330	14,330	7,600	

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	K	L	M	N	O	P	Q	R	S	
D/A ng or ep st	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (F+I+J) *	First Year Cost W/O Mob-Demob (F+I+J) *	Second Year Cost W/ Mob-Demob (D+E)	Second Year Cost W/O Moo-Demob (D)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	I Secon Co W/O Mo
0,819	$1,180,984	$1,110,084	$549,618	$549,618	$631,366	$560,466	$72,620	$72,620	$26,660	$
8,259	1,404,999	1,334,099	730,559	730,559	674,440	603,540	96,530	96,530	28,480	
4,750	1,577,573	1,506,673	825,913	825,913	751,660	680,760	109,120	109,120	31,740	
6,374	1,767,462	1,696,562	921,662	921,662	845,800	774,900	121,780	121,780	35,720	
3,506	1,993,663	1,922,763	1,014,401	1,014,401	979,262	908,362	134,030	134,030	41,360	

2

E

	Q	R	S	T	U	V	W	X
Year t -Demob)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
0,125	$10,360	$10,860	$2,120	$2,120	$145,285	$145,285	$12,730	$12,730
0,125	8,320	8,320	2,120	2,120	123,552	123,552	10,830	10,830
0,125	8,360	8,360	2,120	2,120	123,911	123,911	10,860	10,860
0,125	8,140	8,140	2,120	2,120	122,001	122,001	10,690	10,690
0,125	7,720	7,720	2,120	2,120	118,395	118,395	10,380	10,380

	Q	R	S	T	U	V	W	X
Year t -Demob)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
8,608	$65,150	$65,150	$23,210	$20,210	$1,130,924	$1,057,024	$99,130	$92,650
3,083	89,310	89,310	25,090	22,090	1,384,351	1,310,451	121,340	114,860
9,760	102,100	102,100	28,320	25,330	1,573,820	1,499,930	137,950	131,470
2,076	115,090	115,090	32,220	29,230	1,781,351	1,707,461	156,140	149,660
3,492	127,840	127,840	37,770	34,780	2,027,530	1,953,640	177,710	171,240

	Q	R	S	T	U	V	W	X
Year t -Demob)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
9,967	$16,360	$16,360	$7,600	$7,600	$327,720	$327,720	$28,720	$28,720
9,967	16,170	16,170	7,600	7,600	326,118	326,118	28,580	28,580
9,967	15,910	15,910	7,600	7,600	323,914	323,914	28,390	28,390
9,967	15,320	15,320	7,600	7,600	318,861	318,861	27,950	27,950
9,967	14,330	14,330	7,600	7,600	310,372	310,372	27,200	27,200

	Q	R	S	T	U	V	W	X
Year t -Demob	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
,466	$72,620	$72,620	$26,660	$23,670	$1,280,264	$1,206,374	$112,220	$105,740
,540	96,530	96,530	28,480	25,490	1,530,009	1,456,119	134,110	127,630
,760	109,120	109,120	31,740	28,750	1,718,433	1,644,543	150,620	144,140
,900	121,780	121,780	35,720	32,730	1,924,962	1,851,072	168,720	162,250
,362	134,030	134,030	41,360	38,360	2,169,053	2,095,153	190,120	183,640

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#3

BAYOU CHANNEL: TURNING BASIN (30+00) TO MOUTH (130+00) AND SNAKE BAYOU Rangename: Snake-Below

Disposal Method: Upland, New and Existing ("Charlie") Disposal Areas

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	TOT FIRST W/ MOB- (D+E+F
14+1+1	150,100	$2.21	$331,721	$70,900	$82,575	27	$3,600	$98,604	$162,466	$74
16+1+1	319,300	1.19	379,967	70,900	95,152	61	3,600	220,320	229,719	99
18+1+1	455,500	1.00	455,500	70,900	107,727	71	3,600	255,276	279,167	1,16
20+1+1	626,200	0.88	551,056	70,900	120,304	96	3,600	345,852	277,916	1,36
22+1+1	815,100	0.84	684,684	70,900	132,879	124	3,600	447,876	266,741	1,60

* No Dredging First Year in Bayou Channel; Costs are Lands, Diking and Site Prep.

BAYOU CHANNEL: BRIDGE (0+00) TO MOUTH (130+00) AND SNAKE BAYOU Rangename: Brg-Snk-Below

Disposal Method: Upland, New and Existing ("Charlie") Disposal Areas

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	TOT FIRST W/ MOB- (D+E+F
14+1+1	190,200	$2.01	$382,302	$70,900	$82,575	39	$3,600	$141,192	$202,058	$87
16+1+1	359,400	1.19	427,686	70,900	95,152	73	3,600	262,116	250,910	1,10
18+1+1	495,600	1.02	505,512	70,900	107,727	83	3,600	298,404	299,345	1,28
20+1+1	666,300	0.90	599,670	70,900	120,304	108	3,600	389,952	295,432	1,47
22+1+1	855,200	0.86	735,472	70,900	132,879	137	3,600	492,984	280,063	1,71

* No Dredging First Year in Bayou Channel; Costs are Lands, Diking and Site Prep.

BAYOU CHANNEL: SNAKE BAYOU Rangename: Snake

Disposal Method: Upland, New Disposal Area

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	TOT FIRST W/ MOB- (D+E+F
14+1+1	31,800	$2.54	$80,772	n/a	n/a	10	$3,600	$36,144	$20,418	$13
16+1+1	31,800	2.54	80,772	n/a	n/a	10	3,600	36,144	16,447	13
18+1+1	31,800	2.54	80,772	n/a	n/a	10	3,600	36,144	17,029	13
20+1+1	31,800	2.54	80,772	n/a	n/a	10	3,600	36,144	14,453	13
22+1+1	31,800	2.54	80,772	n/a	n/a	10	3,600	36,144	10,729	12

* No Dredging First Year in Bayou Channel; Costs are Lands, Diking and Site Prep.

SOUND CHANNEL: MOUTH (130+00) TO GIWW (536+00), Option #1 Rangename: Mouth-GIWW

Disposal Method: Open Water, Pt. Aux Pins and Below -12 Contour, Pipeline Dredge

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	Area To Be Grassed Acres	Grassing Cost Per Acre	Grassing Cost Total (G x H)	New D/A Diking or Prep Cost *	TOT FIRST W/ MOB- (D+E+F
14+1+1	828,511	$1.29	$1,068,779	$80,038	n/a	85	$3,700	$314,500	$5,000	$1,44
16+1+1	1,397,000	0.85	1,187,450	80,038	n/a	123	3,700	455,100	7,000	1,72
18+1+1	2,040,000	0.73	1,489,200	80,038	n/a	160	3,700	592,000	9,000	2,17
20+1+1	2,756,000	0.74	2,039,440	80,038	n/a	201	3,700	743,700	12,000	2,83
22+1+1	3,546,000	0.75	2,659,500	80,038	n/a	246	3,700	910,200	15,000	3,64

* Cost of Hay Bales for Stabilization at Pt. Aux Pins.

J	K	L	M	N	O	P	Q	R	S
ew D/A king or Prep Cost	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (F+I+J) *	First Year Cost W/O Mob-Demob (F+I+J) *	Second Year Cost W/ Mob-Demob (D+E)	Second Year Cost W/O Mob-Demob (D)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob
$162,466	$746,266	$675,366	$343,645	$343,645	$402,621	$331,721	$45,400	$45,400	$17,000
229,719	996,058	925,158	545,191	545,191	450,867	379,967	72,030	72,030	19,040
279,167	1,168,570	1,097,670	642,170	642,170	526,400	455,500	84,850	84,850	22,230
277,916	1,366,028	1,295,128	744,072	744,072	621,956	551,056	98,310	98,310	26,270
266,741	1,603,080	1,532,180	847,496	847,496	755,584	684,684	111,980	111,980	31,910

J	K	L	M	N	O	P	Q	R	S
ew D/A king or Prep Cost	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (F+I+J) *	First Year Cost W/O Mob-Demob (F+I+J) *	Second Year Cost W/ Mob-Demob (D+E)	Second Year Cost W/O Mob-Demob (D)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob
$202,058	$879,027	$808,127	$425,825	$425,825	$453,202	$382,302	$56,260	$56,260	$19,140
250,910	1,106,764	1,035,864	608,178	608,178	498,586	427,686	80,360	80,360	21,060
299,345	1,281,888	1,210,988	705,476	705,476	576,412	505,512	93,210	93,210	24,340
295,432	1,476,258	1,405,358	805,688	805,688	670,570	599,670	106,450	106,450	28,320
280,063	1,712,298	1,641,398	905,926	905,926	806,372	735,472	119,700	119,700	34,060

J	K	L	M	N	O	P	Q	R	S
ew D/A king or Prep Cost	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (F+I+J) *	First Year Cost W/O Mob-Demob (F+I+J) *	Second Year Cost W/ Mob-Demob (D+E)	Second Year Cost W/O Mob-Demob (D)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob
$20,418	$137,334	$137,334	$56,562	$56,562	$80,772	$80,772	$7,470	$7,470	$3,410
18,447	135,363	135,363	54,591	54,591	80,772	80,772	7,210	7,210	3,410
17,029	133,945	133,945	53,173	53,173	80,772	80,772	7,030	7,030	3,410
14,453	131,369	131,369	50,597	50,597	80,772	80,772	6,690	6,690	3,410
10,729	127,645	127,645	46,873	46,873	80,772	80,772	6,190	6,190	3,410

J	K	L	M	N	O	P	Q	R	S
ew D/A king or Prep Cost *	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (D+E+F+I+J)	First Year Cost W/O Mob-Demob (D+F+I+J)	Second Year Cost W/ Mob-Demob (none)	Second Year Cost W/O Mob-Demob (none)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob
$5,000	$1,468,317	$1,388,279	$1,468,317	$1,388,279	n/a	n/a	$194,000	$183,430	$0
7,000	1,729,588	1,649,550	1,729,588	1,649,550	n/a	n/a	228,520	217,950	0
9,000	2,170,238	2,090,200	2,170,238	2,090,200	n/a	n/a	286,740	276,170	0
12,000	2,875,178	2,795,140	2,875,178	2,795,140	n/a	n/a	379,890	369,310	0
15,000	3,664,738	3,584,700	3,664,738	3,584,700	n/a	n/a	484,210	473,630	0

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Q	R	S	T	U	V	W	X
IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
$45,400	$45,400	$17,000	$14,010	$808,666	$734,776	$70,880	$64,400
72,030	72,030	19,040	16,050	1,087,128	1,013,238	95,290	88,810
84,850	84,850	22,230	19,240	1,275,650	1,201,760	111,810	105,330
98,310	98,310	26,270	23,270	1,490,608	1,416,708	130,650	124,180
111,980	111,980	31,910	28,920	1,746,970	1,673,080	153,120	146,650

Q	R	S	T	U	V	W	X
IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
$56,260	$56,260	$19,140	$16,150	$954,427	$880,537	$83,660	$77,180
80,360	80,360	21,060	18,060	1,208,184	1,134,284	105,900	99,420
93,210	93,210	24,340	21,350	1,399,438	1,325,548	122,660	116,180
106,450	106,450	28,320	25,330	1,611,028	1,537,138	141,210	134,730
119,700	119,700	34,060	31,060	1,866,058	1,792,158	163,560	157,080

Q	R	S	T	U	V	W	X
IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
$7,470	$7,470	$3,410	$3,410	$148,214	$148,214	$12,990	$12,990
7,210	7,210	3,410	3,410	145,983	145,983	12,800	12,800
7,030	7,030	3,410	3,410	144,385	144,385	12,660	12,660
6,690	6,690	3,410	3,410	141,469	141,469	12,400	12,400
6,190	6,190	3,410	3,410	137,245	137,245	12,030	12,030

Q	R	S	T	U	V	W	X
IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
$194,000	$183,430	$0	$0	$1,662,317	$1,571,709	$145,700	$137,760
228,520	217,950	0	0	1,958,108	1,867,500	171,630	163,690
286,740	276,170	0	0	2,456,978	2,366,370	215,360	207,410
379,890	369,310	0	0	3,255,068	3,164,450	285,310	277,370
484,210	473,630	0	0	4,148,948	4,058,330	363,660	355,710

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#4

SOUND CHANNEL: MOUTH (130+00) TO GIWW (536+00), Option #2 — Rangename: Mouth-GIWW-2

Disposal Method: Open Water, Isle aux Herbes and Below -12 Contour, Pipeline Dredge

A	B	C	D	E	F	G	H	I	J	
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	Area To Be Grassed Acres	Grassing Cost Per Acre	Grassing Cost Total (G x H)	New D/A Diking or Prep Cost *	FI W/ I (D
14+1+1	828,511	$1.29	$1,068,779	$83,035	n/a	n/a	$3,700	$0	$17,500	$
16+1+1	1,397,000	0.85	1,187,450	83,035	n/a	n/a	3,700	0	22,500	
18+1+1	2,040,000	0.73	1,489,200	83,035	n/a	n/a	3,700	0	32,500	
20+1+1	2,756,000	0.74	2,039,440	83,035	n/a	n/a	3,700	0	37,500	
22+1+1	3,546,000	0.75	2,659,500	83,035	n/a	n/a	3,700	0	42,500	

* Cost of Hay Bales for Stabilization at Isle aux Herbes.

SOUND CHANNEL: MOUTH (130+00) TO GIWW (536+00), Option #3 — Rangename: Mouth-GIWW-3

Disposal Method: Open Water, Below -12 Contour, Pipeline Dredge.

A	B	C	D	E	F	G	H	I	J	
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	FI W/ I (D
14+1+1	828,511	$1.59	$1,317,332	$80,038	n/a	n/a	n/a	n/a	n/a	$
16+1+1	1,397,000	1.02	1,424,940	80,038	n/a	n/a	n/a	n/a	n/a	
18+1+1	2,040,000	0.87	1,774,800	80,038	n/a	n/a	n/a	n/a	n/a	
20+1+1	2,756,000	0.82	2,259,920	80,038	n/a	n/a	n/a	n/a	n/a	
22+1+1	3,546,000	0.88	3,120,480	80,038	n/a	n/a	n/a	n/a	n/a	

* No Cost in Second Year for Sound, GIWW or Pass Channels.

SOUND CHANNEL: MOUTH (130+00) TO GIWW (536+00), Option #4 — Rangename: Mouth-GIWW-4

Disposal Method: Open Water, Isle aux Herbes, Pipeline Dredge.

A	B	C	D	E	F	G	H	I	J	
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	Area To Be Grassed Acres	Grassing Cost Per Acre	Grassing Cost Total (G x H)	New D/A Diking or Prep Cost *	FI W/ I (D
14+1+1	828,511	$2.03	$1,681,877	$83,035	n/a	n/a	$3,700	$0	$25,000	$
16+1+1	1,397,000	1.34	1,871,980	83,035	n/a	n/a	3,700	0	30,000	
18+1+1	2,040,000	1.11	2,264,400	83,035	n/a	n/a	3,700	0	40,000	
20+1+1	2,756,000	1.13	3,114,280	83,035	n/a	n/a	3,700	0	45,000	
22+1+1	3,546,000	1.24	4,397,040	83,035	n/a	n/a	3,700	0	50,000	

* Cost of Hay Bales for Stabilization at Isle aux Herbes.

SOUND AND PASS CHANNELS: MOUTH (130+00) THRU PETIT BOIS PASS — Rangename: Mouth-Pass

Disposal Method: ODMDS, Mobile North, Mechanical Dredge and Hopper Barges.

A	B	C	D	E	F	G	H	I	J	
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	FI W/ (D
14+1+1	1,209,000	$1.96	$2,369,640	$771,000	n/a	n/a	n/a	n/a	n/a	$
16+1+1	2,009,000	1.83	3,676,470	771,000	n/a	n/a	n/a	n/a	n/a	
18+1+1	2,912,000	1.80	5,241,600	771,000	n/a	n/a	n/a	n/a	n/a	
20+1+1	3,925,000	1.78	6,986,500	771,000	n/a	n/a	n/a	n/a	n/a	
22+1+1	5,048,000	1.77	8,934,960	771,000	n/a	n/a	n/a	n/a	n/a	

* No Cost in Second Year for Sound, GIWW or Pass Channels.

J	K	L	M	N	O	P	Q	R	S
D/A ng or rep st *	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (D+E+F+I+J)	First Year Cost W/O Mob-Demob (D+F+I+J)	Second Year Cost W/ Mob-Demob (none)	Second Year Cost W/O Mob-Demob (none)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob
17,500	$1,169,314	$1,086,279	$1,169,314	$1,086,279	n/a	n/a	$154,500	$143,530	$0
22,500	1,292,985	1,209,950	1,292,985	1,209,950	n/a	n/a	170,840	159,870	0
32,500	1,604,735	1,521,700	1,604,735	1,521,700	n/a	n/a	212,030	201,060	0
37,500	2,159,975	2,076,940	2,159,975	2,076,940	n/a	n/a	285,390	274,420	0
42,500	2,785,035	2,702,000	2,785,035	2,702,000	n/a	n/a	367,970	357,000	0

J	K	L	M	N	O	P	Q	R	S
D/A ng or Prep Cost	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (D+E+F+I+J)	First Year Cost W/O Mob-Demob (D+F+I+J)	Second Year Cost W/ Mob-Demob (none) *	Second Year Cost W/O Mob-Demob (none) *	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob
n/a	$1,397,370	$1,317,332	$1,397,370	$1,317,332	n/a	n/a	$184,630	$174,050	$0
n/a	1,504,978	1,424,940	1,504,978	1,424,940	n/a	n/a	196,850	186,270	0
n/a	1,854,838	1,774,800	1,854,838	1,774,800	n/a	n/a	245,070	234,500	0
n/a	2,339,958	2,259,920	2,339,958	2,259,920	n/a	n/a	309,170	298,590	0
n/a	3,200,518	3,120,480	3,200,518	3,120,480	n/a	n/a	422,870	412,300	0

J	K	L	M	N	O	P	Q	R	S
ew D/A king or Prep Cost *	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (D+E+F+I+J)	First Year Cost W/O Mob-Demob (D+F+I+J)	Second Year Cost W/ Mob-Demob (none)	Second Year Cost W/O Mob-Demob (none)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob
$25,000	$1,789,912	$1,706,877	$1,789,912	$1,706,877	n/a	n/a	$236,490	$225,520	$0
30,000	1,985,015	1,901,980	1,985,015	1,901,980	n/a	n/a	262,270	251,300	0
40,000	2,387,435	2,304,400	2,387,435	2,304,400	n/a	n/a	315,440	304,470	0
45,000	3,242,315	3,159,280	3,242,315	3,159,280	n/a	n/a	428,390	417,420	0
50,000	4,530,075	4,447,040	4,530,075	4,447,040	n/a	n/a	598,540	587,570	0

J	K	L	M	N	O	P	Q	R	S
New D/A king or Prep Cost	TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (D+E+F+I+J)	First Year Cost W/O Mob-Demob (D+F+I+J)	Second Year Cost W/ Mob-Demob (none) *	Second Year Cost W/O Mob-Demob (none) *	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob
n/a	$3,140,640	$2,369,640	$3,140,640	$2,369,640	n/a	n/a	$414,960	$313,090	$0
n/a	4,447,470	3,676,470	4,447,470	3,676,470	n/a	n/a	587,630	485,760	0
n/a	6,012,600	5,241,600	6,012,600	5,241,600	n/a	n/a	794,420	692,550	0
n/a	7,757,500	6,986,500	7,757,500	6,986,500	n/a	n/a	1,024,970	923,100	0
n/a	9,705,960	8,934,960	9,705,960	8,934,960	n/a	n/a	1,282,410	1,180,540	0

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P	Q	R	S	T	U	V	W	X
nd Year ost ob-Demob one)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
n/a	$154,500	$143,530	$0	$0	$1,323,814	$1,229,809	$116,030	$107,790
n/a	170,840	159,870	0	0	1,463,825	1,369,820	128,300	120,070
n/a	212,030	201,060	0	0	1,816,765	1,722,760	159,240	151,000
n/a	285,390	274,420	0	0	2,445,365	2,351,360	214,340	206,100
n/a	367,970	357,000	0	0	3,153,005	3,059,000	276,360	268,120

P	Q	R	S	T	U	V	W	X
nd Year Cost Mob-Demob one) *	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
n/a	$184,630	$174,050	$0	$0	$1,582,000	$1,491,382	$138,660	$130,720
n/a	198,850	188,270	0	0	1,703,828	1,613,210	149,340	141,400
n/a	245,070	234,500	0	0	2,099,908	2,009,300	184,060	176,120
n/a	309,170	298,590	0	0	2,649,128	2,558,510	232,200	224,250
n/a	422,870	412,300	0	0	3,623,388	3,532,780	317,590	309,650

P	Q	R	S	T	U	V	W	X
cond Year Cost Mob-Demob (none)	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
n/a	$236,490	$225,520	$0	$0	$2,026,402	$1,932,397	$177,620	$169,380
n/a	262,270	251,300	0	0	2,247,285	2,153,280	196,980	188,740
n/a	315,440	304,470	0	0	2,702,875	2,608,870	236,910	228,670
n/a	428,390	417,420	0	0	3,670,705	3,576,700	321,740	313,500
n/a	598,540	587,570	0	0	5,128,615	5,034,610	449,530	441,290

P	Q	R	S	T	U	V	W	X
cond Year Cost Mob-Demob (none) *	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
n/a	$414,960	$313,090	$0	$0	$3,555,600	$2,682,730	$311,650	$235,140
n/a	587,630	485,760	0	0	5,035,100	4,162,230	441,330	364,820
n/a	794,420	692,550	0	0	6,807,020	5,934,150	596,640	520,130
n/a	1,024,970	923,100	0	0	8,782,470	7,909,600	769,790	693,280
n/a	1,282,410	1,180,540	0	0	10,988,370	10,115,500	963,140	886,630

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SOUND AND GIWW CHANNELS: MOUTH (130+00) ALONG GIWW TO PASCAGOULA SHIP CHANNEL (1190+03). Rangename: Mouth-Pasgou

Disposal Method: ODMDS, Pascagoula, Mechanical Dredge and Hopper Barges.

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	TOTAL FIRST COS W/ MOB-DEM (D+E+F+I+
14+1+1	829,000	$1.80	$1,492,200	$771,000	n/a	n/a	n/a	n/a	n/a	$2,263,2
16+1+1	1,485,000	1.71	2,539,350	771,000	n/a	n/a	n/a	n/a	n/a	3,310,3
18+1+1	2,526,000	1.65	4,167,900	771,000	n/a	n/a	n/a	n/a	n/a	4,938,9
20+1+1	4,492,000	1.65	7,411,800	771,000	n/a	n/a	n/a	n/a	n/a	8,182,8
22+1+1	5,866,000	1.65	9,678,900	771,000	n/a	n/a	n/a	n/a	n/a	10,449,9

* No Cost in Second Year for Sound, GIWW or Pass Channels.

PASS CHANNEL: GIWW (536+00) THROUGH PETIT BOIS PASS, OPTION #1 Rangename: GIWW-Pass

Disposal Method: Littoral Zone, Not to Exceed 5000' West of Channel, Pipeline Dredge.

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	TOTAL FIRST COS W/ MOB-DEM (D+E+F+I+
14+1+1	380,000	$0.95	$361,000	$77,982	n/a	n/a	n/a	n/a	n/a	$438,9
16+1+1	611,000	0.78	476,580	77,982	n/a	n/a	n/a	n/a	n/a	554,5
18+1+1	872,000	0.72	627,840	77,982	n/a	n/a	n/a	n/a	n/a	705,8
20+1+1	1,168,000	0.71	829,280	77,982	n/a	n/a	n/a	n/a	n/a	907,2
22+1+1	1,502,000	0.70	1,051,400	77,982	n/a	n/a	n/a	n/a	n/a	1,129,3

* No Cost in Second Year for Sound, GIWW or Pass Channels.

PASS CHANNEL: GIWW (536+00) THROUGH PETIT BOIS PASS, OPTION #2 Rangename: GIWW-Pass-2

Disposal Method: ODMDS, Mobile North, Hopper Dredge

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	TOTAL FIRST CO W/ MOB-DE (D+E+F+I
14+1+1	380,000	$2.03	$771,400	$100,000	n/a	n/a	n/a	n/a	n/a	$871,
16+1+1	611,000	2.03	1,240,330	100,000	n/a	n/a	n/a	n/a	n/a	1,340,
18+1+1	872,000	2.03	1,770,160	100,000	n/a	n/a	n/a	n/a	n/a	1,870,
20+1+1	1,168,000	2.03	2,371,040	100,000	n/a	n/a	n/a	n/a	n/a	2,471,
22+1+1	1,502,000	2.03	3,049,060	100,000	n/a	n/a	n/a	n/a	n/a	3,149,

* No Cost in Second Year for Sound, GIWW or Pass Channels.

GIWW CHANNEL: GIWW (536+00) TO PASCAGOULA SHIP CHANNEL (1190+03), OPTION #1 Rangename: GIWW1

Disposal Method: Open Water, Thin Layer, Less Than 5000' South of Channel.

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	TOTAL FIRST C W/ MOB-D (D+E+F+
14+1+1	0	$0.00	$0	$0	n/a	n/a	n/a	n/a	n/a	
16+1+1	87,817	2.38	209,004	80,000	n/a	n/a	n/a	n/a	n/a	289
18+1+1	485,554	1.32	640,931	80,000	n/a	n/a	n/a	n/a	n/a	720
20+1+1	1,490,705	1.07	1,595,054	80,000	n/a	n/a	n/a	n/a	n/a	1,675
22+1+1	2,320,473	0.80	1,856,378	80,000	n/a	n/a	n/a	n/a	n/a	1,936

* No Cost in Second Year for Sound, GIWW or Pass Channels.

K	L	M	N	O	P	Q	R	S	T
TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (D+E+F+I+J)	First Year Cost W/O Mob-Demob (D+F+I+J)	Second Year Cost W/ Mob-Demob (none) *	Second Year Cost W/O Mob-Demob (none) *	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob
$2,263,200	$1,492,200	$2,263,200	$1,492,200	n/a	n/a	$299,030	$197,160	$0	$0
3,310,350	2,539,350	3,310,350	2,539,350	n/a	n/a	437,380	335,510	0	0
4,938,900	4,167,900	4,938,900	4,167,900	n/a	n/a	652,560	550,690	0	0
8,182,800	7,411,800	8,182,800	7,411,800	n/a	n/a	1,081,160	979,290	0	0
10,449,900	9,678,900	10,449,900	9,678,900	n/a	n/a	1,380,700	1,278,830	0	0

K	L	M	N	O	P	Q	R	S	T
TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (D+E+F+I+J)	First Year Cost W/O Mob-Demob (D+F+I+J)	Second Year Cost W/ Mob-Demob (none) *	Second Year Cost W/O Mob-Demob (none) *	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob
$438,982	$361,000	$438,982	$361,000	n/a	n/a	$58,000	$47,700	$0	$0
554,562	476,580	554,562	476,580	n/a	n/a	73,270	62,970	0	0
705,822	627,840	705,822	627,840	n/a	n/a	93,260	82,950	0	0
907,262	829,280	907,262	829,280	n/a	n/a	119,870	109,570	0	0
1,129,382	1,051,400	1,129,382	1,051,400	n/a	n/a	149,220	138,920	0	0

K	L	M	N	O	P	Q	R	S	T
TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (D+E+F+I+J)	First Year Cost W/O Mob-Demob (D+F+I+J)	Second Year Cost W/ Mob-Demob (none) *	Second Year Cost W/O Mob-Demob (none) *	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob
$871,400	$771,400	$871,400	$771,400	n/a	n/a	$115,130	$101,920	$0	$0
1,340,330	1,240,330	1,340,330	1,240,330	n/a	n/a	177,090	163,880	0	0
1,870,160	1,770,160	1,870,160	1,770,160	n/a	n/a	247,100	233,880	0	0
2,471,040	2,371,040	2,471,040	2,371,040	n/a	n/a	326,490	313,280	0	0
3,149,060	3,049,060	3,149,060	3,049,060	n/a	n/a	416,070	402,860	0	0

K	L	M	N	O	P	Q	R	S	T
TOTAL FIRST COST W/ MOB-DEMOB (D+E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (D+E+F+I+J)	First Year Cost W/O Mob-Demob (D+F+I+J)	Second Year Cost W/ Mob-Demob (none) *	Second Year Cost W/O Mob-Demob (none) *	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Yea Cost W/O Mob-Dem
$0	$0	$0	$0	n/a	n/a	$0	$0	$0	1
289,004	209,004	289,004	209,004	n/a	n/a	38,180	27,610	0	
720,931	640,931	720,931	640,931	n/a	n/a	95,250	84,680	0	
1,675,054	1,595,054	1,675,054	1,595,054	n/a	n/a	221,320	210,750	0	
1,936,378	1,856,378	1,936,378	1,856,378	n/a	n/a	255,850	245,280	0	

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P	Q	R	S	T	U	V	W	X
ond Year Cost Mob-Demob one) *	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
n/a	$299,030	$197,160	$0	$0	$2,562,230	$1,689,360	$224,580	$148,070
n/a	437,380	335,510	0	0	3,747,730	2,874,860	328,490	251,980
n/a	652,560	550,690	0	0	5,591,460	4,718,590	490,090	413,590
n/a	1,081,160	979,290	0	0	9,263,960	8,391,090	811,990	735,480
n/a	1,380,700	1,278,830	0	0	11,830,600	10,957,730	1,036,960	960,450

P	Q	R	S	T	U	V	W	X
ond Year Cost Mob-Demob one) *	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
n/a	$58,000	$47,700	$0	$0	$496,982	$408,700	$43,560	$35,820
n/a	73,270	62,970	0	0	627,832	539,550	55,030	47,290
n/a	93,260	82,950	0	0	799,082	710,790	70,040	62,300
n/a	119,870	109,570	0	0	1,027,132	938,850	90,030	82,290
n/a	149,220	138,920	0	0	1,278,602	1,190,320	112,070	104,330

P	Q	R	S	T	U	V	W	X
cond Year Cost Mob-Demob none) *	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
n/a	$115,130	$101,920	$0	$0	$986,530	$873,320	$86,470	$76,550
n/a	177,090	163,880	0	0	1,517,420	1,404,210	133,000	123,080
n/a	247,100	233,880	0	0	2,117,260	2,004,040	185,580	175,650
n/a	326,490	313,280	0	0	2,797,530	2,684,320	245,200	235,280
n/a	416,070	402,860	0	0	3,565,130	3,451,920	312,490	302,560

P	Q	R	S	T	U	V	W	X
cond Year Cost Mob-Demob none) *	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
n/a	$0	$0	$0	$0	$0	$0	$0	$0
n/a	38,180	27,610	0	0	327,184	236,614	28,680	20,740
n/a	95,250	84,680	0	0	816,181	725,611	71,540	63,600
n/a	221,320	210,750	0	0	1,896,374	1,805,804	166,220	158,280
n/a	255,850	245,280	0	0	2,192,228	2,101,658	192,150	184,210

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#6
GIWW CHANNEL: GIWW (536+00) TO PASCAGOULA SHIP CHANNEL (1190+03), OPTION #2 Rangename: GIWW2
Disposal Method: Littoral Zone, 10,000' South of Channel at Petit Bois Island, Pipeline Dredge.

A	B	C	D	E	F	G	H	I	J	K
Project Depth Feet	Dredging Quantities Cu. Yds.	Unit Price	Excavation Cost (B x C)	Mob and Demob	Existing D\A Rehab Cost	New D/A Size Acres	New D/A Land Cost Per Acre	New D/A Land Cost Total (G x H)	New D/A Diking or Prep Cost	TOT FIRST W/ MOB- (D+E+
14+1+1	0	$0.00	$0	$0	n/a	n/a	n/a	n/a	n/a	
16+1+1	87,817	3.59	315,263	80,000	n/a	n/a	n/a	n/a	n/a	3
18+1+1	485,554	1.99	966,252	80,000	n/a	n/a	n/a	n/a	n/a	1,0
20+1+1	1,490,705	1.30	1,937,917	80,000	n/a	n/a	n/a	n/a	n/a	2,0
22+1+1	2,320,473	1.10	2,552,520	80,000	n/a	n/a	n/a	n/a	n/a	2,6

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K	L	M	N	O	P	Q	R	S	T	
TOTAL RST COST MOB-DEMOB +E+F+I+J)	TOTAL FIRST COST W/O MOB-DEMOB (D+F+I+J)	First Year Cost W/ Mob-Demob (D+E+F+I+J)	First Year Cost W/O Mob-Demob (D+F+I+J)	Second Year Cost W/ Mob-Demob (none) *	Second Year Cost W/O Mob-Demob (none) *	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	Fi P W/ (
$0	$0	$0	$0	n/a	n/a	$0	$0	$0	$0	
395,263	315,263	395,263	315,263	n/a	n/a	52,220	41,650	0	0	
1,046,252	966,252	1,046,252	966,252	n/a	n/a	138,240	127,670	0	0	
2,017,917	1,937,917	2,017,917	1,937,917	n/a	n/a	266,620	256,050	0	0	
2,632,520	2,552,520	2,632,520	2,552,520	n/a	n/a	347,820	337,250	0	0	

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	Q	R	S	T	U	V	W	X
r ob	IDC First Year Cost W/ Mob-Demob	IDC First Year Cost W/O Mob-Demob	IDC Second Year Cost W/ Mob-Demob	IDC Second Year Cost W/O Mob-Demob	First Cost Plus IDC W/ Mob-Demob (M+O+Q+S)	First Cost Plus IDC W/O Mob-Demob (N+P+R+T)	AVERAGE ANNUAL COST W/ MOB-DEMOB	AVERAGE ANNUAL COST W/O MOB-DEMOB
	$0	$0	$0	$0	$0	$0	$0	$0
	52,220	41,650	0	0	447,483	356,913	39,220	31,280
	138,240	127,670	0	0	1,184,492	1,093,922	103,820	95,880
	266,620	256,050	0	0	2,284,537	2,193,967	200,240	192,300
	347,820	337,250	0	0	2,980,340	2,889,770	261,230	253,290

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BAYOU LA BATRE, ALABAMA
MAINTENANCE DREDGING COST
WITH-PROJECT
INCLUDES BERTHING AREAS

CHANNEL SEGMENT & DEPTH	ESTIMATED QUANTITY	UNIT PRICE	EXCAVATION COST	MOB - DEMOB	DIKING AND SITE MANAGEMENT COST	TOTAL COST PER CYCLE
Bayou Channel - into New DA. Sta. 90+45 to T.B.(30+00)						
14 Feet	120,000	$1.58	$189,600	$12,600	$54,000	$256,
16 Feet	120,000	1.58	189,600	12,600	54,000	256,
18 Feet	120,000	1.58	189,600	12,600	54,000	256,
20 Feet	120,000	1.58	189,600	12,600	54,000	256,
22 Feet	120,000	1.58	189,600	12,600	54,000	256,
T.B.(30+00) to Bridge (0+00)						
14 Feet	30,000	$1.58	$47,400	$3,100	$13,500	$64,
16 Feet	30,000	1.58	47,400	3,100	13,500	64,
18 Feet	30,000	1.58	47,400	3,100	13,500	64,
20 Feet	30,000	1.58	47,400	3,100	13,500	64,
22 Feet	30,000	1.58	47,400	3,100	13,500	64,
Bridge (0+00) to -15+55						
14 Feet	15,000	$1.56	$23,400	$1,400	$6,750	$31,
16 Feet	15,000	1.56	23,400	1,400	6,750	31,
18 Feet	15,000	1.56	23,400	1,400	6,750	31,
20 Feet	15,000	1.56	23,400	1,400	6,750	31,
22 Feet	15,000	1.56	23,400	1,400	6,750	31,
Snake Bayou						
14 Feet	10,000	$1.56	$15,600	$1,200	$4,500	$21,
16 Feet	10,000	1.56	15,600	1,200	4,500	21,
18 Feet	10,000	1.56	15,600	1,200	4,500	21,
20 Feet	10,000	1.56	15,600	1,200	4,500	21,
22 Feet	10,000	1.56	15,600	1,200	4,500	21,
Sound & Bayou, 90+45 to 155+00 into existing "Charlie".						
14 - 18 Feet	80,000	$1.40	$112,000	$27,800	$36,000	$175,
20 - 22 Feet	96,000	1.40	134,400	27,800	43,200	205,
Sound & Bayou, 90+45 to 220+00 into expanded "Charlie".						
14 - 18 Feet	210,000	$2.41	$506,100	$27,800	$94,500	$628,
20 - 22 Feet	252,000	2.41	607,320	27,800	113,400	748,
Sound Channel, Sta. 155+00 to Sta. 536+00, Open Water						
14 - 18 Feet	430,000	$0.90	$387,000	$27,800	n/a	$414,
20 - 22 Feet	516,000	0.90	464,400	27,800	n/a	492,
Sound Channel, Sta. 220+00 to Sta. 536+00, Open Water						
14 - 18 Feet	300,000	$0.88	$264,000	$27,800	n/a	$291,
20 - 22 Feet	360,000	0.88	316,800	27,800	n/a	344,
GIWW Channel, Sta. 536+00 to Pascagoula Ship Channel.						
14 - 18 Feet	90,000	$2.00	$180,000	$9,100	n/a	$189,
20 - 22 Feet	108,000	2.00	216,000	9,100	n/a	225,
Pass Channel, Sta. 536+00 into Gulf of Mexico, Pipeline with Discharge West of Channel.						
14 Feet	380,000	$2.05	$779,000	$35,700	n/a	$814,
16 Feet	500,000	2.05	1,025,000	35,700	n/a	1,060,
18 Feet	500,000	2.05	1,025,000	35,700	n/a	1,060,
20 Feet	600,000	2.05	1,230,000	35,700	n/a	1,265,
22 Feet	600,000	2.05	1,230,000	35,700	n/a	1,265,
Pass Channel, Sta. 536+00 into Gulf of Mexico, Hopper Dredge to North Mobile ODMDS.						
14 Feet	418,000	$2.03	$848,540	$100,000	n/a	$948,
16 Feet	550,000	2.03	1,116,500	100,000	n/a	1,216,
18 Feet	550,000	2.03	1,116,500	100,000	n/a	1,216,
20 Feet	660,000	2.03	1,339,800	100,000	n/a	1,439,
22 Feet	660,000	2.03	1,339,800	100,000	n/a	1,439,

TIMATED ANTITY	UNIT PRICE	EXCAVATION COST	MOB - DEMOB	DIKING AND SITE MANAGEMENT COST	TOTAL COST PER CYCLE	TOTAL PRESENT WORTH
120,000	$1.58	$189,600	$12,600	$54,000	$256,200	$863,800
120,000	1.58	189,600	12,600	54,000	256,200	863,800
120,000	1.58	189,600	12,600	54,000	256,200	863,800
120,000	1.58	189,600	12,600	54,000	256,200	863,800
120,000	1.58	189,600	12,600	54,000	256,200	863,800
30,000	$1.58	$47,400	$3,100	$13,500	$64,000	$215,800
30,000	1.58	47,400	3,100	13,500	64,000	215,800
30,000	1.58	47,400	3,100	13,500	64,000	215,800
30,000	1.58	47,400	3,100	13,500	64,000	215,800
30,000	1.58	47,400	3,100	13,500	64,000	215,800
15,000	$1.56	$23,400	$1,400	$6,750	$31,550	$106,600
15,000	1.56	23,400	1,400	6,750	31,550	106,600
15,000	1.56	23,400	1,400	6,750	31,550	106,600
15,000	1.56	23,400	1,400	6,750	31,550	106,600
15,000	1.56	23,400	1,400	6,750	31,550	106,600
10,000	$1.56	$15,600	$1,200	$4,500	$21,300	$71,900
10,000	1.56	15,600	1,200	4,500	21,300	71,900
10,000	1.56	15,600	1,200	4,500	21,300	71,900
10,000	1.56	15,600	1,200	4,500	21,300	71,900
10,000	1.56	15,600	1,200	4,500	21,300	71,900
80,000	$1.40	$112,000	$27,800	$36,000	$175,800	$593,200
96,000	1.40	134,400	27,800	43,200	205,400	692,600
210,000	$2.41	$506,100	$27,800	$94,500	$628,400	$2,138,700
252,000	2.41	607,320	27,800	113,400	748,520	2,546,600
430,000	$0.90	$387,000	$27,800	n/a	$414,800	$1,444,600
516,000	0.90	464,400	27,800	n/a	492,200	1,714,100
300,000	$0.88	$264,000	$27,800	n/a	$291,800	$1,016,400
360,000	0.88	316,800	27,800	n/a	344,600	1,200,200
90,000	$2.00	$180,000	$9,100	n/a	$189,100	$658,800
108,000	2.00	216,000	9,100	n/a	225,100	783,900
380,000	$2.05	$779,000	$35,700	n/a	$814,700	$2,837,500
500,000	2.05	1,025,000	35,700	n/a	1,060,700	3,694,500
500,000	2.05	1,025,000	35,700	n/a	1,060,700	3,694,500
600,000	2.05	1,230,000	35,700	n/a	1,265,700	4,408,200
600,000	2.05	1,230,000	35,700	n/a	1,265,700	4,408,200
418,000	$2.03	$848,540	$100,000	n/a	$948,540	$3,755,700
550,000	2.03	1,116,500	100,000	n/a	1,216,500	4,817,100
550,000	2.03	1,116,500	100,000	n/a	1,216,500	4,817,100
[illegible]	2.03	1,339,800	100,000	n/a	1,439,800	5,701,100
660,000	2.03	1,339,800	100,000	n/a	1,439,800	5,701,100

ATE

LMED

-8

7,000	1,729,588	1,649,550	1,729,588	1,649,550	n/a	n/a	226,520	[illegible]	
9,000	2,170,238	2,090,200	2,170,238	2,090,200	n/a	n/a	286,740	276,170	0
12,000	2,875,178	2,795,140	2,875,178	2,795,140	n/a	n/a	379,890	369,310	0
15,000	3,664,738	3,584,700	3,664,738	3,584,700	n/a	n/a	484,210	473,630	0

2

W/ Mob-Demob	W/O Mob-Demob	W/ Mob-Demob	W/O Mob-Demob				
$194,000	$183,430	$0	$0	$1,662,317	$1,571,709	$145,700	$137,760
228,520	217,950	0	0	1,958,108	1,867,500	171,630	163,690
286,740	276,170	0	0	2,456,978	2,366,370	215,360	207,410
379,890	369,310	0	0	3,255,068	3,164,450	285,310	277,370
484,210	473,630	0	0	4,148,948	4,058,330	363,660	355,710

E-

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3

14+1+1	1,209,000	$1.96	$2,369,640	$771,000	n/a	n/a	n/a	n/a	n/a	$
16+1+1	2,009,000	1.83	3,676,470	771,000	n/a	n/a	n/a	n/a	n/a	
18+1+1	2,912,000	1.80	5,241,600	771,000	n/a	n/a	n/a	n/a	n/a	
20+1+1	3,925,000	1.78	6,986,500	771,000	n/a	n/a	n/a	n/a	n/a	
22+1+1	5,048,000	1.77	8,934,960	771,000	n/a	n/a	n/a	n/a	n/a	

* No Cost in Second Year for Sound, GIWW or Pass Channels.

7,4	n/a	7,757,500	6,986,500	7,757,500	6,986,500	n/a	[illegible]		
2,6	n/a	9,705,960	8,934,960	9,705,960	8,934,960	n/a	n/a	1,282,410	1,180,540
7,5									
5,9									

2